

Connecting Society with Science

# The Greater Potential of Giant Screen Experiences

## Symposium

Monday | September 8, 2008  
Hyatt Regency Jersey City on the Hudson

Preceding the International Conference and Trade Show  
of the Giant Screen Cinema Association

Jersey City and New York City, USA

Sponsored by the National Science Foundation



## Preparatory Material

Organizers on behalf of the GSCA's Lifelong Learning Committee

Emlyn Koster, PhD  
Liberty Science Center

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## Food for Thought

"Once a photograph of the Earth is taken from the outside is available, once the sheer isolation of the Earth becomes plain, a new idea as powerful as nay in history will be let loose."

Fred Hoyle  
British astronomer, 1948

"Science is intimately integrated with the whole social structure and cultural tradition. They mutually support one another- only in certain types of society can science flourish, and conversely without a continuous and healthy development and application of science such a society cannot function properly."

Talcott Parsons  
Sociologist, 1949

"There is but one ocean though its coves have many names; a single sea of atmosphere with no coves at all; the miracle of soil, alive and giving life, lying thin on the only Earth, for which there is no spare."

David Brower  
Conservationist, Founder of Friends of the Earth, 1969

"Science and technology, and the various forms of art, all unite humanity in a single and interconnected system."

Z.A. Medvedev  
*The Medvedev Papers*, 1970

"... the emergence of the central role of museums as both an expression of cultural identity and as a powerful force for human development and education at both the individual and community levels."

International Council of Museums, Santiago  
1972

"Science is curiosity in harness, and curiosity is surely one of the most elemental human motivating forces."

Mahlon B. Hoagland  
*The Roots of Life*, 1979

"The task of the future is to build knowledge and understanding among and between citizens and scientists, so that the distinction between the two groups disappears, so that both become citizen scientists, potentially able to solve our problems together."

Ursula Franklin  
*Planet under Stress*, 1990

"The active citizen of the twenty-first century must be able to intervene with full knowledge of the facts in the ethical, strategic, ecological and technological choices that are being made by society."

*Le Monde*, 1994

"The year is two thousand fifty four. The world is full of curses. People walk the streets no more, no women carry purses. The name of the game is survival now – safety is far in the past. Families are huge, with tons of kids in hopes that one will last. Drugs are no longer looked down upon, they are a way of life. They help us escape the wrenching stress of our world's endless strife ... I wake up now – it was only a dream, but the message was terribly clear. We'd better think hard about the future before our goals and our dreams disappear."

Jessica Inglis, 16

*Great Transitions: Preparing Adolescents for a New Century*, 1995

"Our species needs, and deserves, a citizenry with minds awake and a basic understanding of how the world works. Science, I maintain, is an absolutely essential tool for any society with a hope of surviving well into the next century with its fundamental values intact – not just science as engaged by its practitioners, but science understood and embraced by the entire human community."

Carl Sagan

*The Demon-Haunted World*, 1995

"The leaders of tomorrow's socially responsible businesses will coach and educate others in their organizations to contribute to social result that is bigger than themselves and bigger than their organizations. They will place as much emphasis on building understandings about the complex set of accountabilities that the organization faces, and about the societies in which they live, as they do on improving the organization's abilities and skills to meet these accountabilities."

Greg Parston

*The Organization of the Future*, 1997

"Citizens...are not merely accidental inhabitants of geographically or legally delimited political spaces...They are thinking, knowing and creative beings..."

Sheila Jasanoff

*Science and Public Policy*, 2004

"We prefer to think about ourselves as part of a rapidly progressing civilization that is separate from the timeless natural world. However, paleontologists are more likely to see the entire existence of humanity as an insignificant blip in the geological record and part of the continuous process of evolution. Filmmakers may not be willing to bet that their audiences will take such a view."

Nancy Falxa-Raymond

*The Informal Learning Review*, 2006

"Information that fits a pattern can be remembered; isolated facts don't stand a chance."

American Association for the Advancement of Science

*Learning: The Science Inside*, 2007

# **Giant Screen Films and Lifelong Learning**

Focus Group Conclusions

September 10, 1999

## **Introduction**

This section presents the conclusion of focus group sessions, each a planned representative subset of twelve or so Symposium participants. During each of two 65-minute afternoon sessions, focus groups tackled the questions as listed below—four focus groups on each question in each session. Approximately 55-man hours were spent deliberating on each question.

Lifelong learning:

- Meaning?
- Importance?

Educational giant screen films:

- Optimal development procedures?
- Primary criteria for recognition of superior outcomes?

Flip-note charts of focus group discussions and audio-recordings of summary presentations were used to complete the following summary report on these questions.

## **Lifelong Learning**

Nowadays, learning is a continuous opportunity, neither starting nor stopping with our years of formal education at school, college or university. Indeed, a feature of the e20th century was that it became impossible to learn everything we ought to know during the first decades of life. Learning throughout life helps to maintain personal relevance as informed consumers and decision makers in today's knowledge-based, fast changing society. It helps to assure individual well-being and enable democratic participation. Those who continue to learn during their senior years prolong their mental faculties and overall quality of life.

Lifelong learning emphasizes the learner in us, rather than someone else in the role of teacher. The term usefully shifts the onus and opportunity to use as individuals. Fueled by interest, circumstances and passion, it sums up learning about life, integrating knowledge into life, learning how to get the most out of life, and our place in changing communities. It makes us more informed, more useful citizens, in society. The concept of lifelong learning helps the public put a label on, and a context around, disparate aspects of their lives. For some people, lifelong learning becomes personally transformative, leading to great insights and achievements.

These characteristics of lifelong learning from a consumer perspective carry over in situations where we have a responsibility for the learning of those around us. This has implications for ethical values as well as the overall social and environmental responsibility of leadership in society, whether this be political, corporate, or nonprofit. From an everyday perspective, though, each of us is exposed

continuously to learning situations from a web of leader and follower situations at home, at work, and in play.

Because giant screen films take viewers where they cannot otherwise go, easily or at all—physically, emotionally, intellectually—they have the power to inspire learning at any age. As discussed by several of the authors of advance papers at this Symposium, the giant screen film experience can be an efficient and effective catalyst for generating curiosity and advancing comprehension about the subject matter of the film. Museum-type institutions are in the lifelong learning business and therefore a giant screen theater as part of their menu of educational offerings is a high-profile vehicle for conveying mission. From the standpoint of film makers, the value of lifelong learning provides a direction for the content and approach of their projects.

### **Educational Giant Screen Films**

Giant screen film experiences intended to be educational are optimized by adhering to a systematic series of developmental steps, such as the one that follows:

1. Obtain seed money for conceptual planning and feasibility checks.
2. Develop a conceptual plan for the whole project in terms of learning outcomes, audience targets, preliminary location and storyline planning, and evaluation and marketing methodologies.
3. Assess the project's suitability to the giant screen and the availability of funds for film development and production.
4. Liaise with theaters, especially those with educational missions, to test for interest, gain feedback, and if possible, obtain early 'buy-in.'
5. Present the project as a film-in-development at minimally one GSCA conference.
6. Define learning outcomes for the film in relation to formal education and lifelong learning in the countries where the film is expected to be shown.
7. Develop a detailed outline for the film and any collateral materials making extensive use of content, film, and education experts.
8. Finalize the business plan for the complete project and secure full financing.
9. Decide on a practical filming plan before going on location.
10. Define checkpoints throughout the development process of the film and of any collateral materials to assure ongoing communications with and between all stakeholders. These include reviews of content accuracy by an advisory committee, of educational merits by specialists in school and public education, by audience focus groups, and with project evaluators.

11. Present the project as a film-in-progress at minimally one GSCA conference.
12. Review the script with an industry-wide sample of stakeholders.
13. Develop an alliance with at least one museum-based theater (the same or different as step 4) as a collegial sounding board during finalization in filming, graphics, narration, title testing, etc.
14. Remain flexible at the rough-cut stage for fine-tuning of project details based on industry and audience feedback.
15. Present the project as a new film at the next GSCA conference with documentation on hand about its particular developmental approach as a professional development aid to the industry.

Second, aspiring to superior outcomes with educational giant screen film projects is helped by the following checklist of quality-related questions:

In terms of content, does the film...

- Show the scientific method and scientists at work (or do the same for musicians, artists or others featured in films)?
- Convey useful information, dispel misconceptions and avoid sensationalism?
- Accurately handle educational concepts?
- Encourage reflection and critical thinking?
- Offer new perspectives and pose questions?
- Connect with formal educational curricula?
- Advance the ideals of lifelong learning?
- Provide resources and pathways for further learning?
- Stimulate viewers to discussion about the topic and related issues?

In terms of audience, does the film...

- Appeal to both genders?
- Appeal to a range of ages?
- Have suitability for a family audience?
- Reach out to all ethnic/racial groups?
- Have different language versions?
- Appeal to non-traditional audiences of the medium?

In terms of the overall experience, does the film...

- Present a balance of sensory impacts and intellectual stimulation?
- Deal with subject matter that is effectively handled on the giant screen?
- Create engagement and generate intellectual stimulation?
- Give audiences the "you are there" feeling?
- Help in understanding a broadly important subject matter?

(From Koster, E. (Ed.). (2000). *Giant Screen Films and Lifelong Learning: Compete Symposium Proceedings*. Liberty Science Center, Jersey City, NJ.)



August 22, 2008

Colleagues,

Welcome to this Symposium that explores *Connecting Society with Science: The Greater Potential of Giant Screen Experiences*. On behalf of our Association, I thank you for choosing to participate as part of an industry cross-section. By doing so, you are helping to shape the nature and impact of giant screen film experiences that will help address the science-related opportunities and challenges that face our planet and its inhabitants.

Our industry last gathered in Jersey City on the Hudson waterfront across from lower Manhattan in 1999. That conference and trade show was also preceded by a one-day symposium, *Giant Screen Films and Lifelong Learning*. Since then, we have annually celebrated the *Best Film for Learning*, which recognizes those films that best exemplify the ability of giant screen films to convey information in an entertaining, engaging and compelling manner, and in consequence, encourage lifelong learning. This year's symposium focus on science extends our usual horizons of thinking with the perspectives of a variety of professionals whose interests lie in the communication of science using a spectrum of media.

The Association's Board of Directors thanks the Lifelong Learning Committee with its outgoing chair Emlyn Koster, who as President and CEO of Liberty Science Center has twice hosted our industry. Locally, there have been two remarkable changes between 1999 and 2008. One is the transformation of Jersey City into a sparkling high-rise, green-minded community that embraces its Hudson waterfront. The other is the transformation of Liberty Science Center following its \$109 million expansion and renewal. It has become a globally-minded resource for living, learning and working in, and caring for, the New York / New Jersey region and, according to numerous reports, is a new benchmark of relevancy for the science museum field.

Emlyn and his co-PI on this NSF grant from Rutgers, New Jersey's largest state university, Mary Nucci, have the Board's warm appreciation for their persistent efforts to work with colleagues, secure grant funding, build the program, and organize our dialogue. In both its implementation and its impacts, this important convening has my very best wishes.

Sincerely,

Toby Mensforth  
Chair



August 22, 2008

Colleagues,

I wish to add to Toby Mensforth's sentiments of appreciation and well wishes about the upcoming symposium *Connecting Society with Science: The Greater Potential of Giant Screen Experiences*. Putting on my hat as a science center CEO with a giant screen theater, I know that we need an ongoing flow of innovative film experiences to attract and engage our audiences in science that matters. And putting on my hat as the Association's Vice Chair and Incoming Chair of its Lifelong Learning Committee, I know that we, as an industry, must redouble our collective efforts to help assure that this is indeed the reality going forward.

As an aficionado of space exploration, I must add that it is instructive to reflect that during this 50<sup>th</sup> anniversary year for NASA it has very much been the giant screen film medium that over almost four decades has taken audiences worldwide on powerful journeys into space. Let us imagine that the same could apply to other frontiers of science such as rising sea-level, energy alternatives, ecosystem management, and the human temperament.

The US National Science Foundation has been a stalwart supporter of educational visions using our medium. I commend this agency for supporting efforts to broaden and deepen awareness of its greater educational possibilities through multiple film projects and now two symposia. Also, I thank my colleague Emlyn Koster for his tireless leadership of the industry's lifelong learning committee efforts over the past decade; I thank his co-PI Mary Nucci for her dedicated teamwork in the upcoming symposium; I thank the Lifelong Learning Committee for its support and involvement; and I thank all of you for your gift or time and energy to participate.

In summary, I look forward to the day together and to the onward work of the Lifelong Learning Committee.

Sincerely,

Doug King  
Vice Chair  
and  
Chair, Lifelong Learning Committee



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August 22, 2008

Emlyn Koster, PhD  
President & CEO

Colleagues,

Our chosen way to introduce and contextualize this Symposium is to return to our application for conference funding from the National Science Foundation (NSF) during the fall of 2007. What follows are excerpts from this proposal:

In the context of the major challenges and opportunities the world faces, engaging society with science is surely a vital 21st century need. IMAX®, now approaching forty years of history, and the derivative projection technologies it has spawned have collectively become a popular public brand. And for its part, NSF has become widely established as the main imprimatur of science on the giant screen through its peer-adjudicated grants of US public funds.

During this 50th anniversary year of NASA, it is instructive to recall that it was the giant screen experience that made space flight and exploration tangible to audiences of millions in the post-Apollo generation. Then, during the past three decades, giant screen films have immersed school, family, and adult audiences around the world in journeys of learning to the Moon and Mars, inside our brains and bodies, to the tops of the highest mountains, to oceanic depths to see new crust erupting, and to many of the Earth's ecosystems and their species, ranging from insects to elephants to whales.

Going forward, questions geared to greater relevancy and sustainability must be asked within and of the giant screen film industry. How does the educationally-minded sector of the giant screen industry reach higher levels of achievement and impact? What new science-and-society topics ought to be tackled? Should there be concerted approaches to particular subjects comparable to space exploration in the 1970s and 80s? What innovative new approaches to filmmaking are yet to be developed and how are these best spurred? How do educational theater venues optimize their giant screen program choices? How can the giant screen industry improve the interdependency of its core set of internal relationships? And how will this distinctive and powerful film format, in which so much has been invested, succeed in being more attractive to the next generation?

In our planning, these planned interdependent sets of 2008 Symposium outcomes are geared to the greater potential of giant screen films to augment interest, spark insight, and stimulate action in science-and-society matters among viewers in the almost 200 US theaters and 270 international theaters.

- Extend the value of the 1999 symposium through an increased focus on science in giant screen films and more effective filmmaking

- Ground the conceptualization and production of giant screen films in research on science communication and other allied areas of inquiry
- Strengthen the connection between science and lifelong learning in giant screen films by incorporating best practices in science communication
- Disseminate results through published proceedings, online reporting and a peer-review publication
- Enable dialogue among industry members through the use of a new GSCA listserv about lifelong learning and the giant screen medium to encourage producer-exhibitor-distributor cooperation.

Reflecting NSF's core strength in the specialized area of learning-directed giant screen experiences about science, the focal points of the 2008 symposium are:

- Science-and-society subject matter
- Multidisciplinary inputs to inform innovative approaches in filmmaking with learning goals
- Synergistic producer-exhibitor-distributor relationships.

Experts in cognitive neuroscience, education, science communication, and the evaluation and communication of science and scientific controversy will provide participants with insights on how best to seize upon the greater educational potential of giant screen film experiences. These will be preceded by a review of instructive moments in films that have won the GSTA and GSCA annual Best Film for Learning awards which were an outcome of the 1999 Symposium and followed by two focus-group questions that delve into the Symposium theme.

The Symposium aims to deliver on all of these objectives. Now it is up to all of us – those registered for the Symposium, the leadership authority of the GSCA Board of Directors in terms of leadership influence, and the broader absorption by the industry-at-large as to the nature and significance of what transpired in Jersey City on September 8, 2008.

NSF grant applicants for this GSCA Symposium,



Emlyn Koster, PhD  
President and CEO  
Liberty Science Center



Mary Nucci, MS  
Doctoral Candidate  
Rutgers University

## Acknowledgements

In its conception, preparation, implementation and follow up, this Symposium is a major undertaking that has depended upon the contributions of numerous colleagues.

We firstly express appreciation to GSCA's Lifelong Learning Committee for embracing the idea for this Symposium and assisting with its many subsequent developments; GSCA's Board of Directors for its confidence that the long timeline of effort would indeed reap important dividends for our industry; and the GSCA staff Gretchen Jaspering, Tammy Seldon and Kelly Germain for their indispensable assistance—they were always ready to ably assist with any and all requests.

Also of course, the Symposium's plan could only become a program through the authors who have contributed papers that aim to stretch our within-industry knowledge, filmmakers who have described their approaches to award-winning outcomes, and film school students who after being nominated by their professions have offered assessments of our industry, all of which are in these Advance Materials.

Ultimately though, this Symposium would not be happening without the National Science Foundation (NSF) at its Washington, DC, headquarters and its financial support for the Symposium (Conference Grant DRL-0803987). We thank the anonymous reviewers of our grant request and its program officers Valentine Kass and Sandra Welch.

This marks the second time that the NSF has supported the giant screen industry's efforts to augment the intellectual discipline that surrounds the development of film projects with express intentions of lifelong learning outcomes. Liberty Science Center is honored and pleased to have played a central role in each of these pre-conference, one-day symposia with their published proceedings. On both occasions, the Center's graphic design department has assisted with the publications and we gratefully recognize its creativity.

Soon after the then Giant Screen Theater Association had formalized a strategic plan that stressed the need to better understand our theaters as learning environments, the NSF supported the 1999 symposium entitled *Giant Screen Films and Lifelong Learning* which occurred in New York City. Now comes a sequel focused on *Connecting Society with Science: The Greater Potential of Giant Screen Experiences* in Jersey City. For these two symposia and their associated activities, the NSF grants have totaled almost \$175,000.

We also wish to thank the delegates to the GSCA's 2008 International Conference and Trade Show who kindly opted to come one day earlier and be a contributing part to the next stage of understanding about the greater potential of the giant screen medium to connect society with science. Without all of you, our efforts to date would not have any resulting vitality.

All of this assistance has buoyed the long road of our efforts on behalf of the future significance of the industry that we are all a part of.

With our profound appreciation,

Co-Conveners

Emlyn Koster, PhD  
President and CEO  
Liberty Science Center

Mary L. Nucci, MS  
Doctoral Candidate  
Rutgers University

**Members of the Lifelong Learning Committee**

Doug King	St. Louis Science Center, USA (Incoming Chair)
Alice Apley	RMC Research, USA
Colleen Blair	Fort Worth Museum of Science and History, USA
Paul Bluto	Bransons IMAX Entertainment Complex, USA
Amy Bolton	National Museum of Natural History, USA
Julie Brown	Worlds Biggest Screens Pty. Ltd., Australia
Melanie Checkeris	Ontario Science Centre, Canada
Robin Doty	Museum of Science, USA
Janna Emmel	MacGillivray Freeman Films Educational Foundation, USA
Tim Hazlehurst	Marbles Kids Museum, USA
Valentine Kass	National Science Foundation, USA
Steve Kempf	Giant Screen Films, USA
Tim Knapp	Technicolor/CFI, USA
Emlyn Koster	Liberty Science Center, USA (Outgoing Chair)
Wayne LaBar	Liberty Science Center, USA
Naomi Leissner	Santikos Theaters, Greece
Greg MacGillivray	MacGillivray Freeman Films, USA
Elisabeth Mantello	3D Entertainment Distribution Ltd., France
Mary Nucci	Rutgers University, USA
Chris Palmer	MacGillivray Freeman Films Educational Foundation, USA
Kurt Przybilla	Nanotoon Entertainment, USA
Soames Summerhays	Summerhays Films, Inc., USA
Harrison Smith	MacGillivray Freeman Films, USA
Don Steele	Summerhays Films, Inc., USA

## Preparing for the Symposium

### Before the Symposium

- Please familiarize yourself with the schedule and be prepared to start promptly.
- Please read all of the advance papers. Formulate a response to each paper, listing your questions and other thoughts that arise.
- Most importantly, please bring this book with you to the Symposium.

### At the Symposium

- Complete the pre-Symposium survey upon your arrival to the Symposium sessions.
- As a courtesy, when the Symposium begins, please remember to turn off all cell phones.
- Participate by listening, questioning, and discussing the information presented at the Symposium.
- Challenge your own way of thinking about best practices.
- Take the opportunity to network with others at the Symposium.
- Please participate in question periods and especially in break-out discussions.
- At the end of the day, please complete the post-Symposium survey with honest and thoughtful responses to help guide future industry conferences.

### After the Symposium

- Consider ways to implement what you have learned at the Symposium.
- Continue to question and discuss the Symposium content.
- Disseminate information to others in the industry or in your workplace who could not attend.
- Think about ways that you can enhance the potential of giant screen for connecting science in society.
- Participate in or start discussions about giant screen on the new GSCA listserv.
- And most importantly, please complete the survey that will be sent to you six months after the Symposium.

## **Symposium schedule**

*Note: Schedule subject to change*

**7:15 am Networking Breakfast**, Hudson Pre-Function  
Pre-Symposium Survey

**8:15 am Welcome Remarks**, Hudson I, II, III  
Emlyn Koster, Liberty Science Center, USA  
Valentine Kass, National Science Foundation, USA

**8:30 am Montage of GSCA Best Films for Learning Award Winners**

**9:30 am Speakers**

Science and Visual Communication  
Ann Marie Barry, Boston College, USA

The Inconvenience of Truth: Rethinking the Agency of Science Film  
Spectators in a Post-Postmodern Era  
Lisa Cartwright, University of California-San Diego, USA

Using Telepresence to Communicate Science in Giant Screen Cinema  
Matthew Lombard, Temple University, USA

Picturing Science  
Felice Frankel, Harvard University, USA

**10:50-11:00 am Coffee Break** Hudson Pre-Function

Giant Screen Films and Lifelong Learning  
Alice Apley, RMC Research, USA

The 12 Step Program (for Communicating Science): Mind the Gap!  
Ivan Oransky, Scientific American, USA

Museum Predicaments: (Re) Considering Institutional Forms and Controversy  
in Global Risk Society  
Fiona Cameron, University of Western Sydney, Australia

To be announced  
Jeffrey Sturchio, Merck Inc., USA

Grand Challenge for the Giant Screen  
Randy Atkins, National Academy of Engineering, USA

An Urgent Challenge  
Beverly Sheppard, Institute for Learning Innovation, USA

**12:30 pm Lunch**, Hudson IV, V, VI  
James Hyder, *LF Examiner*

**1:30 pm Breakout session 1**, Hudson I, II, III

One of the main outcomes of the 1999 symposium, *Giant Screen Films and Lifelong Learning*, was a set of guideline steps for the development of films with audience learning goals (see pages 6-8). For films that aim to connect society with science, and with your experience and perspective as well as the content of the morning session in mind, what would be enhancements to the format and content of these film development guidelines? And in what ways could producer-distributor-exhibitor communications be improved?

**Report 2:25-3:00 pm**

**3:00 pm Coffee Break**, Hudson Pre-Function

**3:20 pm Breakout session 2**, Hudson I, II, III

Building on your pre-symposium views on science subject areas of most interest (see note below), the contents of the morning and lunchtime sessions, and mindful of the greater scope of opportunity for giant screen experiences, which five science subject areas do you think would result in the most valuable contributions of our industry to the Earth and human affairs over the next decade? And for each of these subject areas, what would be the two main goals for audience learning and would they need to tackle any controversial matters?

**Report 4:15-4:50 pm**

**4:50 pm Final remarks**

Doug King, Incoming Chair, Lifelong Learning Committee, GSCA  
Toby Mensforth, Chair, Executive Committee, GSCA

**5:00 pm Evaluation and surveys**

Valerie Knight-Williams, Knight-Williams Research Communications

**5:30 pm Reception**, Hudson Pre-Function

**6:00 pm Dinner**, Hudson IV, V, VI

**6:45 pm Dava Sobel** (*Longitude, Galileo's Daughter, The Planets*)

**7:50 pm Final thoughts**

Emlyn Koster, Liberty Science Center

*Note: When asked the question "Please indicate which area of science interests you most" during registration, responses to the pre-set list of areas were Nature/Environment/Ecosystems 28%, Global Warming/Climate Change 17%, Space 17%, Archaeology/Human History 14%, Evolution 7%, Oceans 7%, Nanotechnology 4%, Genetic Engineering/Cloning 4%, Engineering 1%, and Medicine 1%.*

## **Lifelong Learning Award: Best Film for Learning Criteria and Award Winners**

The Best Film for Learning Award of the GSCA recognizes that film that best represents the development and presentation of giant screen film experiences from a lifelong learning point of view. To be eligible, films must have been produced in their original form specifically for giant screen theaters, premiered in giant screen theaters, and released and played at a member's theater after May 1 of the previous award year. Films must meet the following criteria set by the Lifelong Learning Committee:

- ✓ The film conveys useful information and/or dispels misconceptions and encourages reflective/critical thinking.
- ✓ The film introduces new roles and perspectives.
- ✓ The film uses familiar starting points but stretches viewer interests and extends their knowledge.
- ✓ The film is entertaining and compelling.
- ✓ The film motivates viewer interest in the film's topic.
- ✓ The film provides a variety of experiences to meet the needs of viewers of different ages and from different backgrounds.
- ✓ The film provides effective educational resources for further learning.
- ✓ The film aspires to be meaningful to multinational audiences and languages.

2001 Best Film for Learning  
*Dolphins* (2000)

2002 Best Film for Learning  
*The Human Body* (2001)

2003 Best Film for Learning  
*Jane Goodall's Wild Chimpanzees* (2002)

2004 Best Film for Learning  
*Bugs!* (2003)

2005 Best Film for Learning  
*Forces of Nature* (2004)

2006 Best Film for Learning  
*Roving Mars* (2006)

2007 Best Film for Learning  
*Hurricane on the Bayou* (2006)

## Best Film for Learning: Filmmakers Essays

Each of the filmmakers of the Best Film for Learning award were asked to select 3-4 minutes of film that they believed provided the best examples of learning in giant screen, and in a short essay, to address the following question:

*The criteria for the award for Best Film for Learning are: the film conveys useful information and/or dispels misconceptions and encourages reflective/critical thinking, introduces new roles and perspectives, uses familiar starting points but stretches viewer interests and extends their knowledge, is entertaining and compelling, motivates viewer interest in the film's topic, provides a variety of experiences to meet the needs of viewers of different ages and from different backgrounds, provides effective educational resources for further learning, and aspires to be meaningful to multinational audiences and languages. Did these criteria play a role during production of the film? If so, please describe how you used them. Regarding the segments you selected, why do you think they provide the best learning moments from your film? How do these segments relate holistically in terms of learning to the entire film?*

### **Greg MacGillivray, Director**

*Dolphins*, 2001 Best Film for Lifelong Learning

The scene provided to the Lifelong Learning GSCA symposium sets up the dolphin communication research of scientist Kathleen Dudzinski. In this three-plus minute sequence audiences learn about the technology Kathleen developed to record dolphin communications, the difficulties of studying dolphin communication and how her camera technology helps her overcome them, what she is observing and paying attention to, how she tracks the dolphins she's studying, what questions she has and then what further questions she develops as she conducts her research. In an interesting way – with dolphins – our film shows audiences how scientific inquiry works.

During *Dolphins'* scripting our team developed learning goals for the film, about a dozen of them that spanned the spectrum of U.S. National Science Standards. The following are examples of some of the learning goals we set for the film, in particular what the film could help audiences understand about science and scientists, and are reinforced throughout the film.

- Marine scientists construct ideas, conduct research, and gather important and extensive information about dolphins, their habitat and the ecology of the oceans.
- Scientists utilize analytical reasoning, critical thinking skills and creativity as they engage in the scientific enterprise.
- Scientists rely on new techniques and tools to enhance the gathering and manipulation of data and to provide new evidence to guide inquiry.

- There are limits to what we know about dolphins, and there is much opportunity for future scientists to make important contributions.

One positive (and unplanned) outcome was related to the young scientists in the film. Kathleen Dudzinski and Alejandro Acevedo proved to be excellent role models for young viewers. As the film developed we created an educational outreach program that emphasized their involvement. With funding from National Science Foundation and MacGillivray Freeman Films, we sent Alejandro and Kathleen to 19 cities to promote the film and meet with underserved student groups to talk about science as a career. We developed a "Science Career" video that they used on their tour and Kathleen also made her email address available to viewers. The response from students, teachers, parents and school principals was very positive, and showed that audiences were responding to the idea that girls can and should do science, that it's important to show diversity among scientists, and that marine biology is a positive way to bring children to science.

Other noteworthy outcomes (that most people don't know about): MacGillivray Freeman Films funded the development of a new camera for Kathleen, one that detects the sonar clicks of the dolphins. And the work that was done in Patagonia with dusky dolphins in the second half of the film was actually new scientific research for that location, also funded by MacGillivray Freeman. It was fun for us to see that our film could contribute directly to scientific research, not just "portray" scientific research to audiences.

### **David Lickley, Director**

*Jane Goodall's Wild Chimpanzees*, 2003 Best Film for Lifelong Learning

In crafting our film, we were aware that one of our most important goals was to educate and inform a broad international audience. While we never analyzed things in terms of the criteria for the Best Film for Learning award, we were nonetheless cognizant of the educational impact our film might have. We wanted above all to appeal to audiences of all ages, to provide an in depth learning experience, and to motivate people to want to learn more about chimpanzees, the plight they face, and the work being done by Jane Goodall.

Every scene in the film has a specific purpose. Some provide background on the events that took place during Jane's time at Gombe National Park in Tanzania. Others cover the range of behaviors that make up the chimpanzee repertoire. When taken as a whole, the film tries to present a holistic look at the world of the chimpanzee, and draws meaningful comparisons between chimpanzees and their closest living relatives, human beings. When you look at the behaviors captured on film by our crew, and hear the story through Jane's perspective, you come away with a sense of just how intelligent, adaptive, and human-like these animals really are. One of the most important scenes of the film takes place at a termite mound in the middle of the forest. The shots of a young chimpanzee breaking off a twig, stripping it of leaves, and using it to probe for termites were the most difficult ones to capture in our nearly 15 weeks of shooting. We all knew it would take some

extraordinary good fortune to be in the right place at the right time, and when we got those shots in the can, we knew how we wanted to drive the storyline towards that pivotal moment.

The discovery of termite fishing is perhaps the single most important scientific breakthrough from the nearly 30 years of Dr. Goodall's research in Tanzania. It was also one that was crucial to the film's overall educational message. The creation of a tool by a chimpanzee in order to capture termites was instrumental in breaking down the barrier that had long separated humans from the rest of the animal world. Before that time, we were known as Man the Tool Maker. The impact of Jane's discovery cannot be underestimated and led to a re-examination of the whole field of animal behavior. It's one thing to read about the event. It's quite another to see it unfold on the giant screen and hear through the voice of the world's most famous primatologist. There are few moments in the life of scientist that produce that kind of impact on the world. The impact of that day on Jane herself is something that she manages to convey in an emotional and compelling way. We let the audience share in her discovery, and I think it is something that they will carry with them for years afterwards.

At a more subtle level, the scene helps to deliver the message that we humans share more than just our genes with other creatures in the animal kingdom. It makes the demise of the chimpanzees and their habitat later in the film all the more tragic when you consider how much like us they really are.

### **Phil Streater, Producer**

*Bugs!* 2004 Best Film for Lifelong Learning

At PLF and SK Films we think that good films cannot be rushed! I can say that, given that *Bugs!* came out in 2003 and we haven't yet started production on the follow up, *Flight of the Butterflies!*

PLF attended the 1999 GSTA symposium and we took a tradeshow stand to display the *Bugs!* concept. I have to say from the start that we certainly did not set out to make a film that ticked lifelong learning boxes. We set out to make an entertaining film about insects in the rainforest. That being said, we think there are a number of very useful lessons learnt in the process of "concept to screen" that are pertinent to the creation of a film that works well for lifelong learning.

This original treatment was full of good, solid, entomology: exoskeletons, global numbers, importance in the food chain, importance as pollinators, sheer complexity and diversity. But, to be honest, that treatment was a bit of a list, loosely built around the basic areas of eating, movement, camouflage, fighting and breeding. The central theme was, "Insects are vital to all life on earth, what is the secret of their success?" A perfectly noble starting point, but one in danger of going down the "illustrated lecture" path of filmmaking.

However, the development phase of the film coincided with the setting up of an organisation called the European Educational Large Format Film Forum (ELF), run by Sarah Mumford out of Bradford's National Museum of Photography, Film & Television. Sarah had given an interesting paper at GSTA's 1999 Symposium, so I took up her offer to present the *Bugs!* treatment to an assembled group of museum heads of education, gathered at Bradford under the ELF banner. I gave them each an illustrated copy of the treatment (the same treatment, incidentally, that Jonathan Barker and I had presented to Terminix which secured their sponsorship commitment, and also to a number of museums and secured pre-lease agreements – so it can't have been that bad!) and let them read and annotate it right there in front of me and then we discussed it.

But, it was taking the 20 marked up treatments back to the office that was the really useful thing about this exercise. It prompted a fundamental shift in emphasis as to how we actually set about making the film. Naturally, there were good educatory comments everywhere, "Avoid unconditional statements we can't prove...", "...Good for adaptation in Key Stage 2..." etc. But it was a short comment at the end of one mark up that changed the direction of the development process, "There could be more of a story..." Simple, but profound.

Mike Slee, the director, got involved and we had a "story" brainstorm and came up with the idea of choosing and combining the lifecycles of two of our large cast of characters – a butterfly and a praying mantis. We nearly had our story. We added the somewhat audacious angle of one protagonist preying on the other, Mike then added the hut as a background human element and a home for our characters, and we *did* have our story.

Fast forward to the narrator and the narration, and to two clips from the film. We cast Judi Dench as "the-grandmother-who-is-brilliant-at-telling-stories." The first clip illustrates a wonderful use of metaphor on the one hand and how Judi Dench settled the audience into an unfamiliar world and started the story on the other. The second clip demonstrates how only a few words can turn the whole tone of a film. This is an excerpt from the narration script that was signed off by investors, theatres and our sponsor, Terminix:

*"Papilio's brief life may be over but insects are the ultimate survivors. Yet, as habitats disappear, many insect species are lost - some even before we have discovered them and their secrets.*

*However, one thing is for certain - in the battle to survive on this planet, if the insects lose, then so do we."*

Powerful it may have been, but this is the final narration script from the second clip:

*"Papilio's life has run a natural course.*

*Against the odds she has completed one of the greatest journeys in nature - from caterpillar to butterfly.*

*Though Papilio's life was brief, it has not been wasted.*

*This wriggling hungry bug is Papilio's offspring.*

*Just like its mother this tiny caterpillar is beginning its own intrepid journey.*

*Joining trillions of other insects, the latest recruit into the extraordinary world of bugs."*

If we had left the narration as it was in the signed off version of the script it would be a different film today. Maybe a significant learning point about humankind's impact on the planet would have been made on an intellectual level. But, instead we kept the audience in the world of bugs right to the end. From the moment Judi Dench says, "Our story unfolds..." until "...the extraordinary world of bugs" we are contained within a narrative, a powerful story. This was our way of giving audiences the most entertaining and educational film we could think of. We feel audiences now leave the theatre thinking and feeling what an amazing place the jungle is and aren't insects incredible. We want our audiences to be fascinated by insects and the rainforest and to fall in love with them. The learning comes a subliminal second. After all, "You protect what you love, you love what you understand, you understand what you learn."

### **George Casey, Director, Co-Producer**

*Forces of Nature*, 2005 Best Film for Learning

At the 2005 Achievement Awards for the Giant Screen Theater Association, *Forces of Nature* received an award for Best IMAX Film of 2005 and another for Best Learning Film of its year. The awards were a culmination of years of filming erupting volcanoes, tornadoes, and the aftermaths of powerful earthquakes filmed almost entirely in the 15 perf/70 mm IMAX format--widely regarded as the world's more powerful, most realistic motion picture format.

We felt confident that a spectacular natural disaster would occur which would allow us to showcase our remarkable collection of footage. But when? And where? The answer came with the news of a spectacular eruption of a volcano on the British island of Montserrat in the Caribbean. There, in an extraordinary, month-long period from September 22 to October 21 in 1997, a spectacular succession of 76 huge, explosive eruptions rocked the island, propelling gigantic ash clouds more than a dozen miles into the sky, forcing the evacuation of half of the island, and generating world-wide coverage.

The footage which we filmed we considered among the finest natural disaster footage ever captured on giant screen film. Now, it was time to assure its use. At the next GSTA consortium meeting, we exhibited the footage on the giant, IMAX

screen. Executive producers Lisa Truitt and Tim Kelly of National Geographic saw the footage and after learning that the eruptions and the exceptional drama of Montserrat were continuing, soon proposed that it was now the time that we partner together in an IMAX format film with a new working title of *Forces of Nature*. The film took form as we wrote and rewrote the treatment to satisfy repeated submissions to the NSF and to meet the high standards of our science advisors and our team.

We were pleased from the outset with how well our partnership with National Geographic worked. We arrived at early decisions to limit *Forces of Nature* to volcanoes, earthquakes and tornadoes. Each would have their own separate sections within the film. Each would feature a young, brilliant, articulate, dedicated scientist who was engaged in cutting edge research in their science and who would appear on-camera carrying out their work, often under dangerous conditions. They would, no doubt, become role models to many younger viewers.

Our partnership with National Geographic has been the natural outcome of our shared passion for capturing the awesome power and realism of nature. Through *Forces of Nature*, we wanted the audience to see and experience what we experienced as we chased tornadoes, felt the rumble of the shaking earth, and tasted that tremor of terror in recognizing that we were (visually and audibly, at least) suddenly being jolted captive within a major earthquake.

Through the extraordinary realism of the world's most powerful and realistic film format, we wanted the audiences of *Forces* to undergo the "you are there" experiences of witnessing the deafening, screen-filled explosion of Montserrat's volcano, to behold its enormous, roiling ash clouds thrusting and billowing 15 miles above the island, and to directly face the onrushing terror of pyroclastic flows hurtling down the flanks of the volcano at more than 100 miles per hour, bearing the searing certainty of incineration in its 1,000-degree interior.

Because that's what we were after: to take audiences perilously close to these most dangerous of nature's forces: real eruptions, real pyroclastic flows, real tornadoes, and the most realistic re-creation of one of nature's most monstrous earthquakes. That was our goal for *Forces of Nature*. And perhaps, now, for a new level of Best of Learning footage.

For that's what we've always felt that IMAX and other large format systems could be: giant simulation chambers brining audiences ever closer to reality...even closer than you'd ever want to be. And that is how and why we were able, for example, to reproduce the giant Izmit earthquake of August, 17, 1999, and to bring it to life again and again for audiences in theaters around the world in *Forces of Nature*.

Knowing that accurate seismic readings of the quake had been recorded on location in Turkey, we hastened to verify that these recordings could be replayed and recreated on the giant shake table of the Richmond Earthquake Simulation Facility of the University of California in Berkeley. Here, we had already commenced filming full scale earthquake simulation tests for *Forces of Nature*, testing more

advanced designs for homes, structures, and the infrastructure of huge, modern buildings and cities designed to survive alongside California's notorious San Andreas Fault.

Knowing that these tests were ending, we sought the opportunity to use the very same three story building, thoroughly refurbished as interiors of an Izmit food store, an Izmit apartment house, and an Izmit garage to film an identical 7.4 earthquake assaulting our own 'ersatz Izmit'. It worked. In fact, it worked so well that at the end of our weekend orgy of re-created earthquakes we were informed that our Izmit look-alike building could survive only one more 7.4 simulation 'quake-take'.

I offered the suggestion that we might increase the power of the last simulated quake by a small magnitude to "entirely use up the building." Our host seismologists agreed. And so, if you've seen *Forces* and are ever asked if you've experienced an earthquake, you may truthfully answer that you have (VISUALLY and AUDIBLY) survived one which was even stronger, (and for that one shot, especially) than the great Izmit earthquake of 1999.

*Forces of Nature* was also host to a wide range of other special effects re-creations. As the film's Director of Cinematography, Sean Casey later created (and destroyed at high frame rates) very convincing miniatures of middle of the night exteriors of multiple story Izmit buildings to give the quake sequence a greater scale and believability.

Computer animation was convincingly created by Sassoon Film Design and Pixel Play Studios to carry our audiences to otherwise inaccessible worlds of the primordial earth and within the interiors of Turkey's earthquake faults and Montserrat's volcano to make more understandable the mechanisms and forces of plate tectonics and earth's interior.

There was, for me, a rare, frustrating aspect to directing *Forces of Nature*. Yes, we could include a remarkable amount of information, but there was so much more to learn and impart than was possible in 40 minutes of screen time. Especially about the individual science and lives of our remarkable scientists-researchers, Dr. Ross Stein of the US Geological Survey, Dr. Marie Edmunds of the British Geological Survey, and Joshua Wurman of the Center for Severe Weather Research, as well as other scientists and their deep convictions about the importance of their work and their dedication to the protection of humankind, so many of whom remain at constant risk around the world, whether beneath the flanks of Montserrat, on the plains of Tornado Alley or among the crowded 15 million residents of Istanbul, living a scant 20 seconds from disaster. I remain impressed—no, inspired—by their dedication to their science and to their fellow human beings and their willingness and courage to risk the very real dangers they sometimes must.

## **George Butler, Director**

*Roving Mars*, 2006 Best Film for Learning

The idea for making *Roving Mars* came from an overheard phone conversation – I was in an editing room working on another IMAX (*Shackleton's Antarctic Adventure*) in the Fall of 2001, when my editor, Tim Squyres, began discussing a NASA mission to Mars. When Tim hung up, he turned to me and said: “My brother, Steve, works for NASA and he’s the head of the science team that’s sending two rovers to Mars. They have pretty good cameras on board and they can reproduce IMAX size images. You should think about a film on the mission.” “IMAX quality images?” I asked, betraying my immediate interest. “I believe so,” replied Tim.

“Well,” I thought, “Who on earth would *not* want to see Mars on an IMAX screen?” I asked Tim for his brother’s number. Soon we were meeting and exploring the possibilities of a film. I contacted Frank Marshall, the producer of many of Stephen Spielberg’s films and thereafter he took the project to Disney. We would produce the film together and I would write and direct.

A team fell into place, including Scott Swofford, the line producer of fourteen IMAX films. The question Disney wanted answered in short order was: can NASA really shoot IMAX quality images 300 million miles away on Mars and transmit them safely back to earth? Disney technicians were dubious. I called Steve Squyres. “No problem,” said Steve. “Let me drive over from the Jet Propulsion lab to Burbank and show them how this works.” Steve drove from Pasadena to Burbank and convinced Disney the rover cameras were so good that if it were necessary they could assemble mosaic digital images as big as a football field to show exactly what Mars looked like – on Mars. Then he convinced the Disney people that he could get these images back to earth and make them accessible to my editor (in this case, Nancy Baker).

Now we needed a story. The crew was assembled and my two cameramen T.C. Christensen and Reed Smoot started shooting. My films demand good characters and we were getting this through extraordinary access to the mission from Dr. Charles Elachi, the head of JPL, and Sean O’Keefe, the head of NASA, to every aspect of the mission. The film became a story of what America does best: space missions that are shepherded by large teams of rocket scientists and engineers working toward a success that transpires in space.

We shot exhaustive preparations that demonstrated successes and failures of the race to prepare the rovers for launch. This was a technical process but, we were able to build a three-act story that was based on the fervent hopes of the scientists and engineers that the mission might succeed – and not go wrong. This drama was supported by the dazzling images of the rovers and their rockets as they were meticulously prepared.

To teach an audience anything, it is critical to get their attention and then involve them in a dramatic story. In this case, the early story was about the pressure to pull a successful mission together. These often involved close shots where we could

convey both terror and fervent belief in the very eyes of its scientists and engineers, who were charged to make a great and successful mission out of the impossible demands of the time constraint involved. Fortunately I was able to get some great shots of mission control where the absolute tension of everyone involved was once again worn on their faces. The eventual success of the landing on Mars was extremely moving, as the faces of mission control broke out into unfettered delight as it became evident that the first rover, "Spirit", had successfully landed on Mars.

As the launch and landing were successful, the human drama of getting the rovers to Mars soon gave way to a scientific mission: was there evidence of water on Mars? Water is essential to life. However, as the story progressed, I was now dealing with two rovers ("Opportunity", the second rover, had now joined "Spirit" on Mars). I tried to make these rovers as lifelike and human as possible. All the drama that was created earlier in the film was intended to bring empathy to the rovers. The human drama that made the expedition possible vested great interest in the viewers to some relatively dry science. What made the science interesting was the human drama in preparing the rovers for launch and then seeing them land successfully on Mars. The audience would be cheering the science lab rovers by the time they got to work on Mars. We had humanized science.

The story now became the search for water (or evidence that conditions existed for the possibility of life on Mars). This was done by two golf cart size rovers. With some luck "Opportunity" landed in a crater that had strong evidence that water had once flowed there. The science lesson had a dramatic resolution: there was once water on Mars. It was discovered by two resourceful rovers, 300 million miles away from earth.

### **Greg MacGillivray, Director**

*Hurricane on the Bayou*, 2007 Best Film for Learning

*Hurricane on Bayou* uses the power of giant screen images and the tremendous visual information the screen can convey to create learning moments throughout the film. This film uses that natural giant screen asset and takes it to the next step. *Hurricane on the Bayou* tells a story that is emotional and significant for our times.

The almost 4-minute segment provided to the Lifelong Learning Symposium focuses on what happened to Louisiana's wetlands from the perspective of one of the film's leading characters, Tab Benoit, a Cajun musician who lives in the Bayou. In this segment, the film uses personal testimony of this former pilot turned musician, combined with a telling series of aerials that convey the story of the destruction of the wetlands over time. Striking images of diminished islands – now like sandbars – are seen over narration that tells us this was once a sugar plantation more than a mile wide. Narration reveals that the brown water we see in the ocean is soil that no longer replenishes the wetlands. A flyover of long man-made canals through the bayou, which we're told allow saltwater intrusion, lead to a shot of a forest of

standing dead trees. The scene also uses historic images from the Mississippi levees as well as a computer generated image of Louisiana showing its diminished coastline from 1930 to 2000. All of the information presented in this scene are layered over beautiful or striking imagery and told from the perspective of someone who has lived it. In under four minutes, audiences have learned why the wetlands are disappearing – seen it for themselves in a dramatic way -- and have been set up to understand how wetlands can alter the impact of a hurricane.

From a planning and scripting point of view, this film was unique in that much of the footage shot originally was replaced, and the story was retold, based on the occurrence of Hurricane Katrina. The entire film had to be re-thought and re-edited after the disaster. The images we obtained after the storm, combined with the emotional stories of our characters allowed us to show how environmental changes affect natural disasters and the resulting impact this has on people, society and our culture. Because Hurricane Katrina had been a story that received so much media coverage, audiences were coming to the film with varied expectations, and certainly our story of the wetlands was a new take on the event. Audience testing was key to the editing process to help us sort through all of the audience expectations.

Theatres used the film and its message to do some outreach that motivated caring actions by audiences. For example, Pittsburgh, St. Louis and Birmingham hosted young women at a screening where they brought school supplies with them to donate to New Orleans students. The program, led by the national Girls Math & Science Partnership was titled "Girls Helping Girls." In Irvine, California, underserved students painted a giant mosaic about the wetlands and New Orleans with a message "We Care" that they sent to a school in New Orleans. One young viewer told us that from the film he learned that "my family matters the most." *Hurricane on the Bayou* is an example of a giant screen film that successfully combines learning with emotion, proving that they aren't mutually exclusive.

## Advance Papers

Experts in cognitive neuroscience, education, science communication, and the evaluation and communication of science and scientific controversy were asked to provide participants with insights on how best to seize upon the greater educational potential of giant screen film experiences. In preparation for the Symposium speakers were asked to respond to the following question in their pre-symposium papers:

*This symposium will examine the greater potential for giant screen films in the communication of science to the public. The public is defined in this case as anyone who views a giant screen film, acknowledging the fact that each audience member may have a unique motivation for choosing to watch the film. The audience for giant screen films ranges from 8 to 80 years old, and a typical giant screen audience can be comprised of school children on a class trip, families on a day trip to a museum or science center, seniors visiting with a tour group, and tourists from around the world. From your research focus, please discuss your perspective on the need for improved science communication, best practices in communicating science, how to communicate science and science controversy effectively, and the role and future for the communication of science in visual formats. In your discussion, please also specifically address social and environmental needs and issues for science communication in terms of what people need to know about science to function effectively in the world of today and tomorrow.*

### **Giant Screen Films and Lifelong Learning**

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*From our evaluation work, we have come to understand giant screen films as films defined not only by their visual and visceral qualities, but as films that deliver scientific knowledge, including depicting facts, processes and perspectives to audiences of a variety of ages and backgrounds, interests and experiences, that are primed and ready for learning.*

Visitors come to science centers to see beautiful things, to experience new technology, and to learn. Giant screen films are among those experiences. Evaluation offers a way to understand the audiences' reactions to these experiences. In recent evaluation work, we've seen some innovative approaches to leveraging the incredible visual and visceral power of the giant screen medium in the pursuit of rich educational experiences.

Our research suggests that while catering to people of diverse ages and interests, these films have been successful in delivering both excellent science content and storytelling. Based on the large format film evaluations we've conducted over the last decade, we've found that the potential of giant screen films as an effective medium for science learning lies in fully utilizing film language and current technical abilities. Rather than relying solely on the spectacle of the giant screen, films that use cinematic language and techniques to defamiliarize the ordinary, transport viewers to new places, including worlds outside of the everyday human view; that use the medium to manipulate scale and time, such as through macrophotography and slow motion; that juxtapose perspectives; that introduce characters and human motivations; in short, that fully engage the dramatic and storytelling potential of the medium, result in effective learning.

This paper presents some highlights of what we've learned about giant screen audiences and effective science communication from a series of National Science Foundation-funded evaluations of giant screen film.<sup>1</sup> Evaluations are typically conducted both during formative stages of project development and at the conclusion of project implementation. Formative evaluations provide audience input that can be integrated into project design at various stages of the development to ensure both appeal and effective science communication. Summative evaluation is conducted to assess a film's success in conveying science content. Evaluators are also interested in understanding popular appeal, audience engagement, and interest in the topic of the film.

### **Audiences expect great science content and great storytelling**

Giant screen audiences are diverse; they include a wide age range, from young children to senior citizens, and can include experts as well as novices. The unifying factor, however, is that visitors in science centers are relatively well-educated, with a higher proportion of college and advanced degrees than held by the average American.

And while some audience members are looking forward most of all to the swooping helicopter shots, others dread those very moments and find them nauseating. But the common denominator between the thrilled and the nauseated is the expectation that a giant screen film will intellectually engage and even challenge them. In discussions, we hear time and again that audiences hope to be exposed to the latest in scientific thinking and imaging. They expect to leave with some new information, having seen fresh visualizations of science content, or gained a new perspective on something familiar. And we've never had audiences tell us there was too much science in a film.

For any particular film, we find audience members from very different background levels – from complete amateurs to professionals. For instance, we've spoken with ten year old dinosaur aficionados with extensive knowledge of paleontology in

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<sup>1</sup> RMC Research has conducted formative and summative evaluations of six NSF-funded films, *Cosmic Voyage*, *Lost Worlds: Life in the Balance*, *The Human Body*, *Wired to Win: Surviving the Tour de France*, and *Dinosaurs Alive*

reviews of materials on a dinosaur film, and practicing doctors and biologists attending a screening of a film on human biology. Across topics we also find there are audience members with no knowledge of the content at all. So each audience member's starting point for learning varies enormously. A film can serve as an introduction to a topic for one person, a refresher for another, and an opportunity to fill in gaps of knowledge for yet another.

Over the years in which we have been conducting giant screen evaluations, we have seen changes in how the public views the medium. When the giant screen experience was still relatively new, audiences approached these films as unique science center experiences, and largely regarded them as distinct from the movies you might see at your local Cineplex. Today we find that discussions about a giant screen film are as likely to provoke comparison with other giant screen experiences, as with films and television shows. No conversation we had about *Dinosaurs Alive* occurred without reference – from adults at least - to *Jurassic Park*, and when discussing the possibility of a film on Antarctica, focus group members unfailingly referred to *March of the Penguins* and *An Inconvenient Truth*. We have found that audiences will readily discuss giant screen films in terms of both the science content and the storytelling, and critique them in the context of a wide field of media offerings. Along with this has come a set of expectations about excellent storytelling.

### **New developments in giant screen film**

In recent evaluation work we've pinpointed some real success stories, which we hope will raise questions about different ways of thinking about learning and about these films more broadly. The examples are going to be drawn from three recent films, all of which received major National Science Foundation funding: *The Human Body*, *Wired to Win: Surviving the Tour de France*, and *Dinosaurs Alive*. In the summative evaluations of each of these films, we surveyed audiences both pre-viewing and post-viewing (approximately 300 pre- and 300 post-viewing audience members for each) and conducted focus groups with smaller numbers of viewers.

Questions looked at the acquisition of factual content and new learning, but also at other ways in which people learned, including attitudinal change, and learning that enriched the depth and context of knowledge. We designed questions to probe learning related to content delivered in visual and in audio tracks, and conducted analysis aimed at identifying particular scenes and stories that were successful in engaging audiences in the science content. The following examples are just a small sampling of the information and issues addressed in each evaluation.

#### ***The Human Body*: Take something ordinary and make it new**

*The Human Body* film (2001, Discovery Pictures/BBC co-production in association with the Science Museum, London and the Maryland Science Center, Producer/Director: Peter Georgi. Producer/Writer: Richard Dale. Executive Producer: Jana Bennett) was based on one episode of a multi-part BBC television series on the biology of the human body. *The Human Body* film explored different body systems and was loosely structured around a day-in-the life of the human body, beginning with the burning off of a retinal layer when you open your eyes in

the morning. Woven into the day-in-the-life structure was an exploration of the body over the lifecycle, from the ability of new babies to hold their breath underwater to aspects of what happens when we age.

As part of the summative evaluation of *The Human Body* film, we asked audience members how they felt about their bodies. Before viewing the film, the largest number of responses referred to people's immediate bodily conditions, such as "healthy," "fit," "overweight," "good," "tired," and "out of shape." After viewing the film, the responses were markedly different. Audiences described their bodies as mechanical or organic wonders, using words such as "amazing," "marvelous," "miraculous," "awesome," "fascinating," "incredible," "fantastic," "extraordinary," "intricately made," "cool," "complicated," and "complex." For instance, viewers said, "It's an amazing machine!" "Awesome! Only God could make it," "I could still use a tattoo, but it's amazing," and "I feel the same but different."

When we contacted a small group of viewers after seeing the film (anywhere from two to eleven weeks later), twenty-four of the twenty-eight interviewees said they had thought about the film since seeing it. When we asked them what they remembered from the film, it was this big picture message that they recalled most clearly, though they also had excellent recall of various visuals from the film, many of which were recalled in association with particular experiences and activities, such as surgeries and bicycle riding. Some of the respondents said that they changed how they felt about their bodies, and a few even reported changing their behavior. They related a new awareness about what happens when you eat, sleep and move, and responding to a detailed sequence about the impact of loud music on the ear, they had been concerned about their hearing.

What *The Human Body* film did so successfully was to take something ordinary and familiar to every audience member – the human body – and make it new. The universality of the topic, based on the fact that everyone has a body, allowed viewers to feel personally connected with the film. Through a carefully structured approach that presented the average, living body, the film offered an overview of different body systems, with a few deeper stories. The success was in how these stories were knit together to present the body as a single system. The film helped audiences see their bodies through a scientific lens, to see the body as a system, to think of it in terms of function, and it gave viewers a visual language for thinking about bodily structures and systems. The filmmakers were able to achieve this through an integration of medical imaging, CGI and live action footage captured in a variety of media formats, including video, 35mm film, and giant screen images.

### ***Wired to Win: Integrating science and story***

*Wired to Win* (2005, PD Productions, a division of Partners HealthCare System. Director/Writer: Bayley Silleck. Senior Producer/Project P.I: JoAnna Baldwin Mallory) built on many of the strengths of *The Human Body* film, embracing human biology as a suitable topic for a large format film, and mixing vérité footage and medical imaging. But rather than structure the film around the artifice of a day in the life, they used the Tour de France bike race to provide a dramatic narrative,

and interwove this with stories of how the human brain functions in ways which allow us to do both the ordinary and extraordinary.

Again, the film had universal appeal and a strong overall message. Audience members indicated that this overall message had to do with the relationship between the brain and body, and the plasticity of the brain. A visual image of neural networks repeated throughout the film was consistently mentioned by audiences as shaping this bigger message. Audience members described their learning from this image as "How the pattern of neurons firing help shape and form the body's action. How the brain is constantly rewiring in the learning process," "Brain keeps changing, synapses work together over time," "how nerves learn, nerve signals travel 300 km/hour," "brain is always developing and learning new pathways," and "How the wiring in the brain changes." In addition to this larger message, the film was also successful in conveying some detailed information about other aspects of brain and body interactions.

One aspect of our summative evaluation looked specifically at which scenes, stories and themes were most effective at conveying science content to audiences. In addition to a series of pre/post questions on factual content, and self-perception of knowledge in different areas, viewers were asked to rate the film's effectiveness in communicating key themes and scientific content, and to describe both memorable images and science learned in a series of open-ended questions.

Audience responses consistently pointed to a sequence on how the body experiences and attends to pain as standing out in its effectiveness in communicating rich science content. In this sequence, the diverse elements of the scientific and human stories came together. Focusing on the experience of a single rider as he struggled to overcome the pain of the climb, the scene combined both traditional giant screen imagery of sweeping French landscapes, and close up shots of riders' grimaced faces. The sequence was intercut with graphics illustrating the transmittal of pain signals from leg to brain, and the body's response through the release of endorphins. And it was further enriched by the development of the rider's character, motivation for the race, and subjective voice-over describing his experience of the pain. It was a topic that viewers felt had been thoroughly presented, and could easily recall the details of the sequence, including the explanations about how the "brain feels the pain" and how "the neurons tell us the pain that we feel." They also accurately retained details about the role of endorphins in easing pain.

What we found in our analysis was that the areas of greatest learning generally coincided with extended discussion of science content in the narration, which was motivated by the characters' activities and included characters' first-person reflections on their experiences, as well as clear visuals. The wide appeal of the characters' struggles and nearly universal experience of bicycling, even though many viewers knew little about the Tour de France, was effective in engaging a wide audience. The stories of motivation and of setting goals and struggling to achieve them were compelling to viewers of all ages and backgrounds. Even some of the students who struggled with the science content of the film were drawn in by the very human struggles of the riders. And while many audience members

expected that the film would profile Lance Armstrong, few were disappointed in the focus on “underdogs” instead.

### ***Dinosaurs Alive: Bringing science alive***

The *Dinosaurs Alive* (2007, Produced by David Clark, Inc., Giant Screen Films, Maryland Science Center, and Stardust Blue in association with the American Museum of Natural History.. Writers/Directors: David Clark and Bayley Silleck. Producer: David Clark. Executive Producers: Greg Andorfer, Don Kempf) film is structured around a series of explorations of dinosaur science, and links paleontological study and methods as conducted during a historically significant expedition led by Roy Chapman Andrews in 1920, with contemporary field and laboratory methods and understandings. The focus on paleontological work provides opportunity for vérité sequences and human stories, and an investigation of the process of scientific discovery provides the overall theme for the film. This was a film that had, obviously, a topic highly appealing to young children – and it had also a need to appeal to the adults who accompany children. Therefore, the film-makers integrated several types of film material, including archival footage from Chapman’s 1920 Gobi Desert expedition as well as computer generated renderings of different species of dinosaurs.

We found that in terms of educational impact, the stand-out scenes in this film were ones in which the computer generated images were used to bring to life hypothetical scientific phenomena and to guide viewers into the scientists’ imagination. In one scene, recreations of rains and flooding were used to illustrate how dinosaur fossil deposits were created, and in another, a fossil of a feathered dinosaur morphs into a fully rendered flying animal. Audiences were particularly impressed with these scenes, and noted them as among the most memorable scenes. The topics dealing with the relationship of birds and dinosaurs, and the exploration of the role of climate in fossil preservation were noted as among the greatest areas of learning by viewers.

The film’s successes in this regard are suggestive of the potential of the medium for taking visual evidence such as actual fossils shown in live footage, and using computer generated images to help viewers imagine the worlds investigated by science. As noted by a focus group participant, these scenes helped viewers understand the imagination necessary for scientists to develop new theories and for science to progress. Viewers were particularly enthusiastic about the information content of this film, and the use of these kinds of imaging, and way in which they were woven into a narrative structure looking at actual paleontological stories of scientific discovery, may also have contributed to the positive sense viewers had of the informational content of the film.

### **Summary**

Each of these films has pushed the giant screen medium in significant ways. Through their use of a richer cinematic language, whether introducing footage from various film formats, vérité-style footage, character-driven stories, and innovative integration of computer animation and live footage, they all make use of cinema’s

ability to defamiliarize, to juxtapose, and to visualize in the creation of meaning as discussed in this paper.

What we've learned about the audience:

- Audiences bring their sophistication about media – gleaned from what is possible on television documentary and in feature films – to their experience and critique of giant screen films.
- The science center location for these films is meaningful; audiences expect first-rate science content, in terms of accuracy, cutting-edge visualizations, and opportunity for learning. Audiences are primed for learning when they walk into a giant screen presentation

Best practices for effective science communication

- Storytelling matters, and science content and story – offering drama, characters and opportunities for audiences to find personal relevance – should be well-integrated with the science content, e.g. character's can provide the motivation for exploring specific science content
- Reinforce information presented in audio and visual tracks with one another; new ideas content can be broken down both visually and in audio tracks and layered to provide more complex content
- Exploit different film formats including diverse source material, and different genres, such as documentary and archival footage, CGI, and scientific imaging to develop both story and science content
- Visualize what cannot ordinarily be seen and what is difficult to imagine, such as scientific theories and processes
- Expand the notion of landscape to include internal worlds and familiar things made new
- Address content in terms of a larger take-away message, as well as through the development and exploration of individual themes and stories.

As the number of films being made increases, there is opportunity for different kinds of films, and many possible types of successful films. From our evaluation work, we have come to understand giant screen films as films defined not only by their visual and visceral qualities, but as films that deliver scientific knowledge, including depicting facts, processes and perspectives to audiences of a variety of ages and backgrounds, interests and experiences, that are primed and ready for learning.

From our analysis of the films discussed we see that giant screen film producers are embracing new opportunities for dramatic storytelling and finding ways of deepening the science content of these films. While staying true to the unique immersive qualities of the medium, the most successful learning moments are ones in which filmmakers are drawing on a range of cinematic techniques including dramatic arcs and cinema vérité realism, and integrating multiple film formats and the use of CGI to transport viewers to new and unfamiliar worlds.

## Grand Challenges for the Giant Screen

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*So I urge the giant screen industry to focus more on issues that will determine the world's future and less on dinosaur reenactments. The Grand Challenges, our world's giant topics, also deserve to be displayed on a giant screen. But, as we think about the engineering challenges of the future and how to apply the latest film-making technologies to communicate about them, we should never lose sight of the fact that the mode of communication is not a substitute for great storytelling.*

### Introduction

Technological illiteracy is a major threat to the future of the United States. Even as our world is transformed by engineering achievements and U.S. citizens become more dependent on the conveniences modern technology provides, most of us are in the dark about how any of it – from cars to computers, I-phones to Internet – works. Most of us don't care. We are in ignorant bliss and the media – both news and entertainment – are a big part of the problem.

The world faces significant challenges, most of which engineers will be called upon to help address. The problems are fairly well documented, because the media thrives on scaring us with doomsday scenarios. The potential solutions are not well known, however, nor does the public know about the heroes trying to solve these challenges. They are engineers – a profession most people still think drive trains, mix music (for, say, IMAX films), or change light bulbs in our offices.

The public does not understand the contributions engineers have already made. Engineers have transformed scientific discoveries in ways that dramatically improve and extend lives. Here are twenty examples, from National Academy of Engineering's *Greatest Achievements of the Twentieth Century*<sup>2</sup>: electrification, the automobile, the airplane, water supply and distribution, electronics, radio and television, agricultural mechanization, computers, the telephone, air conditioning and refrigeration, highways, spacecraft, the Internet, imaging, household appliances, health technologies, petroleum/petroleum technologies, laser and fiber optics, nuclear technologies, and high-performance materials.

These engineering achievements changed our lives. The giant screen industry should strive to better tell the stories behind those breakthroughs, or what those engineers are working on for this century. The key word is *stories*. There are compelling stories, and characters, behind the technologies that are molding our lives. Giant screen films would be more successful if they spent more time on the story, not just the audio-visual experience. Frankly, there may be too many giant

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<sup>2</sup> From <http://www.greatachievements.org/>.

screen films on natural science – dinosaurs, sea monsters, and such – to the exclusion of interesting engineering subjects.

### **Communicating engineering in popular culture**

Part of the problem, including in this symposium, is a focus on “*science* communication.” Too often, in fact, we use the term “science” as a catch-all when we’re really talking about “engineering.” Science is a critical to engineering’s many success stories, but it is different from engineering. The distinction is important for the public to understand as we seek to address the challenges of the century ahead. The role of engineers needs to be common knowledge. It needs to be a part of popular culture.

Science is the quest to understand how nature works. Engineering is the quest of humans – engineers – to use scientific knowledge, within nature’s constraints, for meeting people’s needs and wants. The public doesn’t understand those concepts, just as they don’t understand modern technologies that are central to our daily lives.

Technological literacy used to be important at the consumer level, for example in being able to understand whether to buy a product and which one. However, today we only see the outside package, and are seldom given the opportunity to understand the modern technology behind products. They may as well be magic. Consumers do not build modern devices or repair them when they break. We are not easily given the chance, or the incentive to understand, unless it is through school or media. Few in the media are up to the challenge of engagingly explaining how the modern engineered world works. There are real, untapped opportunities here for creative people.

Beyond their daily lives, the public isn’t prepared to help guide and support the policies that will ensure we meet society’s wants and needs for the century ahead. In a democratic society, we are asked to make choices that depend upon technological issues, from oil drilling to stem cells to surveillance cameras. Modern media, such as giant screen films, could help. Former Vice President Al Gore already made a film (though not in giant screen format), *An Inconvenient Truth*, on one such topic. But, typically, it focused mainly on problems and not the solutions. Engineering is about solutions. Well-produced and well-researched films could help citizens understand issues and obstacles, guiding informed opinions on how to address many of the world’s challenges. There is an important opening for creative people in the giant screen industry – explaining today’s technologies and creating enthusiasm to support the development of tomorrow’s technologies.

To be more successful, the giant screen industry should not just rely on the power of size and awe. Producers should focus more heavily on telling stories that resonate, and include strong characters. Engineering provides this opportunity, because it is more than applying science to solve problems. The engineering process toward achieving a successful technology involves complex combination of science, ethics, politics, law, and sometimes life-risking work.

And, of course, technology isn't always good. The engineering process includes unintended consequences. Modern advances can sometimes be used for nefarious purposes. Some may benefit from certain technologies more than, or even to the detriment of, others. But all of this can make great storytelling.

Feature films haven't traditionally been kind to engineers or scientists (the mad scientist is much more common than the heroic engineer). The giant screen industry should pick up where Hollywood has failed. Create some engineering heroes (without super powers). There is a wonderful synergy between the giant screen format and engineering stories because they offer dramatic visuals – the audacity of giant construction projects, innovative techniques for probing distant worlds in space, tools for exploring the mechanics of Earth, bioengineering that can reveal the inner workings of own bodies. The challenge is to do more than provide “eye candy.” Since engineering is about the human endeavor, telling compelling and important stories should be easy.

A giant screen experience can, indeed, help. In today's world, where more and more people have big screens home, it can take a giant screen to draw audiences into theaters. Further, the giant screen can provide much more detail, and that's potentially important when explaining complex engineering. Giant screen films can also bring about positive change by powerfully motivating viewers to get involved. These mammoth films are unique because the screen is so large that you feel enveloped by it. You feel pulled in to what's on the screen, as if you are practically there and part of the process. The giant screen allows you to get away with explaining complex issues, because the audience is more easily drawn in.

We need to convince, and incentivize, creative film producers and storytellers to use the giant screen format for tackling important issues. Scientists, engineers, and film makers should meet for regular brainstorming sessions. The discussions should include story ideas as well as how to ensure scientific and technical accuracy. Accuracy might even be used as a novel way to attract viewers. Perhaps the giant screen industry could publicize its films as being vetted by an expert National Academy (National Academy of Sciences, National Academy of Engineering, Institute of Medicine) committee for accuracy.

There have been workshops designed to tackle such issues by attempting to turn scientists and engineers into scriptwriters. While I like the general idea and goals, I doubt it will ever actually result in a blockbuster film production. I am proposing something similar, but fundamentally different. Instead of trying to teach one professional how to do another professional's job, let's facilitate collaboration. We should organize an ongoing series of meetings that brings scriptwriters and producers together with scientists, engineers, and medical experts to brainstorm ideas. Just as important, such meetings would simply allow people from widely different cultures to better understand each other.

Ideas to start the discussion could come from the National Academy of Engineering's recently announced *Grand Challenges for Engineering in the 21<sup>st</sup>*

*Century*<sup>3</sup>. The findings are the product of an international committee of some of our generation's leading technological thinkers. The group, chaired by former U.S. Secretary of Defense William J. Perry, included such technology pioneers as Google co-founder Larry Page, genome decipherer J. Craig Venter, Nobel Prize winner Mario Molina, former National Institutes of Health head Bernadine Healy, and prolific inventors Dean Kamen and Ray Kurzweil, among others<sup>4</sup>.

The topics proposed by the committee illustrate that the century ahead presents challenges that would have at least as much impact as the *Great Achievements of the 20<sup>th</sup> Century*. Since I would like to encourage – even challenge – the giant screen industry to make these *Grand Challenges* the subject of a series of films, I will briefly outline them (specific challenges in bold) below.

### **Challenging the giant screen industry**

Foremost among the challenges giant screen producers should address are those that must be met to ensure the future itself. The Earth's growing population is using resources at a rate that cannot be sustained forever. There is a dramatic race to develop new sources of energy. At the same time, engineers are working on preventing and reversing the degradation of the environment. Addressing vulnerabilities to health from disease and preventing terrorist attacks will require much engineering ingenuity. And, beyond reacting to threats, pursuit of the joy of living will always be a priority of engineering innovators. All of these pursuits should be documented.

Among the "holy grails" of powering our future are to **make solar energy economical** (The Sun's rays bathe Earth's surface with more energy each hour than the planet's population consumes each year) and **provide energy from fusion** (producing the Sun's power source here on Earth to generate a virtually limitless supply of clean energy). The engineering quest to capture power from these sources could include dramatic visuals of solar arrays, huge atomic containment machines, and more.

Success with solar or fusion energy, however, will not quickly replace fossil fuels and their environmental impacts. The threat of global warming makes the capture of carbon dioxide emissions an urgent priority. The ability to **develop carbon sequestration methods** on the large scale required, securing it away in places – like the deep ocean – where it won't get back into the atmosphere, is a huge undertaking that could most effectively be portrayed on a huge screen.

A less well-known environmental challenge is to **manage the nitrogen cycle**. Nitrogen is the most common element in the atmosphere. The cycle by which it is taken up by plants, into the food chain, and back to the atmosphere has been drastically altered by industrial processes and fertilizers used for agriculture. The results include smog, acid rain, polluted water, and greenhouse gases. Engineering

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<sup>3</sup> See <http://www.engineeringchallenges.org/>.

<sup>4</sup> Details can be found at the project website, <http://www.engineeringchallenges.org>.

breakthroughs must be found to re-balance the system in a hungry world. This is an untold story.

The ability to **provide access to clean water** is an ever increasing concern and is already urgent in many parts of the world. Innovative new technologies will be needed for both personal and large-scale water needs. People in the U.S., however, don't feel the urgency.

The above challenges certainly relate to human health but, more a more direct one is the challenge to **engineer better medicines**. While modern medicine has tackled many diseases, many more remain resistant to effective treatment, and biomedical engineering is pursuing the goal of personalized medicine. While each of us is unique, today's treatments are mostly one-size-fits-all. Scientists and engineers probing deeper into the biology of our bodies may soon come up with medical technologies specific to you. What could be more personally relevant and engaging?

Simulation will become a more and more important medical tool. The biggest such challenge may be to **reverse-engineer the brain**. Such an achievement would surely offer advanced treatments for neurological diseases, new approaches in the quest for artificial intelligence, and a window to a better understanding mysteries like consciousness. It's a window film-makers might consider shooting through.

Fooling our brains into thinking we are in certain environments, to **enhance virtual reality**, has applications ranging from military exercises to medical training to long-distance meetings that provide face-to-face interaction without travel. This may also be the next step in the giant screen experience!

Increasingly sophisticated computing technologies methods will also allow us to **advance health informatics**. In addition to better and more efficient handling of health records, potential applications include automated diagnoses, analysis of treatment options, and tracking of disease. They can be dramatic, life-and-death issues.

Threats to our well-being come from many sources. Engineering solutions are badly needed to prevent and warn about dangers from natural sources and to counter the violence of terrorists. Chief among concerns may be to **prevent nuclear terror**. And as our world becomes more and more dependent on the Internet, a significant challenge will be to **secure cyberspace** from malefactors. Engineering technologies to detect and prevent these threats early is of vital concern, but we have become complacent as 09/11/01 recedes further into history.

Of course, reacting to threats is only part of engineers' challenges. Engineers have always contributed to the joy of living. The quest to **restore and improve urban infrastructure** offers the opportunity to show how engineers confront environmental and logistical obstacles while enhancing the aesthetic and practical appeal of the cities where most of the world's population lives.

Engineers are working to improve the ways we gain knowledge, but **advancing personalized learning**. Studying the fascinating process by which we learn, engineers are working to tailor instructional methods to individual minds for maximum benefit. It's not something feature films can easily do today, but it's a topic to explore.

Technology is also contributing to the discovery of mass knowledge, as they **engineer the tools of scientific discovery**. More and more intricate and powerful devices will be needed as we probe deeper into the unknown realms from the far reaches of space to the inner-working of atoms. These topics are often covered in giant screen films, but the engineers' roles usually aren't.

## **Conclusions**

That is certainly not an exhaustive list of the challenges engineers will face in the 21<sup>st</sup> century. But they are key ones, and may provide a useful guide of both visual and important stories as giant screen producers choose topics.

Engagingly portraying these vital issues for the public, and humanizing those working to address them, is of crucial importance – both for the U.S. and the world. We should document this century's technological progress in ways that draw in the public and involve them in the process. It's not too strong a statement to say that our very survival may depend upon how engineers address the Grand Challenges of Engineering, and public understanding will be a key to making that happen.

Finding practical solutions to problems like poverty, health, and energy will, in large part, require the ingenuity of skilled engineers. Their work has brought the modern conveniences much of the world enjoys. Their future challenges include bringing the fruits of progress to the rest and teaching those people how to sustain progress themselves. Like the successful engineering challenge of the "moon shots," it can be done, with political will and public support.

We need the artists of film to dramatically make these points in a way that resonates with the public. The giant screen medium can add to and amplify the power of the content. Film producers should use this advantage to step up to the challenge of engagingly discussing specific ways of meeting future goals for humanity. Currently no media truly draws people in to a substantive dialog on the important issues. Our entertainment is shallow.

The NAE *Grand Challenges for Engineering* project should start a serious national dialog about the engineering challenges, including any potential negative consequences. This country must rekindle the enthusiasm for science and engineering that made the U.S. a world leader. Engineers changed the way we live during in the 20<sup>th</sup> Century. That shouldn't be taken for granted, and must be extended to others with whom we share this shrinking world, as we look toward the century ahead.

While there are many global challenges for engineering, realizing them may depend less on engineers than on political leaders. That's why it's important to build public

backing, which translates into political action. Giant screen films can be a part of that process.

So I urge the giant screen industry to focus more on issues that will determine the world's future and less on dinosaur reenactments. The *Grand Challenges*, our world's giant topics, also deserve to be displayed on a giant screen. But, as we think about the engineering challenges of the future and how to apply the latest film-making technologies to communicate about them, we should never lose sight of the fact that the mode of communication is not a substitute for great storytelling.

## Science and Visual Communication

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*Since in reality there is no more important or fascinating story to tell than that of science, it seems essential that scientists themselves begin to see the importance of visual storytelling in educating the public mind, and to actively use visual media as a means to establish an awareness in the scientific classroom of what things exist and can exist, and to tell real stories about how things work and how they will evolve.*

"How the brain enables the mind is *the* question to be answered in the twenty-first century."

Michael Gazzaniga

*The Mind's Past*, 2000

### Theoretical Perspectives

In this essay, I would like to address the need for improved science communication and the reciprocal relationship between science and visual communication.

The need for improved science communication begins, to my mind, first, with the application of neurological research and accepted psychological principles to the study of visual communication; and secondarily and consequentially, with a general and more advanced public understanding of the ways in which images work to influence attitude, thought and action. Because the visual media has come to dominate how we take in information, visual media has now been established as a primary foundation for both individual and public mind formation. In this endeavor, science is key, and plays a double role:

Through current scientific technology we have gained the ability to understand how the mind/brain receives information, processes it, derives meaning from it, and uses it. By using new neurological insights gained through technology, we gain both an understanding of how our minds continue to develop in this new world where vision predominates, and a firmer foundation for predicting the consequences of the consumption of visual images through the neurological principles that govern visual impact. As I have argued extensively elsewhere (Barry, 1997), all communication theory and all assumptions about the way we process images and the impact they have on us must be compatible with scientific neurological research.

Second, in complement, science can profit from the use of visualization both in learning and in creativity. Visualization enables the imagination in ways that allow science to take advantage of (what might be called) our "visual mind bias." Because visualization has become a predominant way of understanding reality, our predisposition to visualize concepts is an ideal platform for visual artists in science to use advanced visual technologies to reveal the invisible micro- and macro-worlds

which science affirms, yet which the average person cannot imagine without what Marshall McLuhan might have called significant “sensory extension.”

### **Science in Visual Communication**

Within the past 30 years, primarily through the power of functional magnetic resonance imaging (fMRI), computerized tomography (CT), positron emission tomography (PET), and near-infra-red spectroscopy (NIRS), we can now view exquisitely detailed images of the brain and learn what parts are active in performing various visual, oral, and computative tasks. With the availability of such techniques, neuroscience has been able to build a map of how the brain’s modules function and communicate with one another in solving particular problems and undertaking specific tasks. The image that we ultimately perceive is unified not because the mind sees a picture of what is really “out there,” but because the specialized areas in the visual cortex link four parallel systems into a vast network, in which reentrant connections allow information to flow both ways.

One of the key characteristics of visual processing advanced by recent scientific experiment is the presence of fundamentally two information-processing systems in the brain—the cortical pathway and the thalamo-amygdala pathway. Until the mid-1980s, it was generally hypothesized that emotion had to come *after* conscious and unconscious thought processing. Richard Lazarus (1982), for example, argued that emotional reaction required cognitive appraisal as a precondition. We now know, however, that the brain accomplishes its goals in the absence of conscious awareness. In visual communication process, sensory signals from the eye travel first to the thalamus and then, in a kind of short circuit, to the amygdala *before* a second signal reach the neocortex. As Neuroscientist Joseph LeDoux explains: “The cortical systems that try to do the understanding are only involved in the emotional process after the fact” (1986, p. 241).

This is because there exists in the brain a “fundamental dichotomy—between thinking and feeling, between cognition and emotion” (LeDoux, 1998, p. 15). This dichotomy, and the primacy of emotions in laying the groundwork for further thought, and their ability to override thought and incite action despite what logic may otherwise dictate, has profound implications for the preconscious impact of visual media—which by the very nature of its business exploits emotional impact to gain box office returns. The higher the emotional impact of the experience, and the more often the experience is repeated, the greater the influence on the subsequent patterns of thought in the individual perceiver.

Thus science reveals through its technology images of how the mind works. And through these images is revealed the power of other visual images to move people’s emotions before they are consciously aware of it, and to frame the form that thought will take. Science thus plays a most significant role in policing theory formation in disciplines like visual communication that rely on assumptions about how the mind works.

It is also significant in theory formulation that the older emotional pathway, which allows raw emotions to connect with the thinking areas of the hemispheres, seems

to be most deeply connected to both imaginations' metaphoric visualization and to creative thought itself. Again and again, for example, great creative minds explain their creative thought generation in terms of visual imagery and their reliance on mental images as springboards for extending their understanding well beyond the parameters of verbal language or logic.

Roger Shepard—artist, writer, and recipient of the National Medal of Science—has theorized that in thinking visually, we go beyond sense data and make automatic inferences, developed through evolution, to guide perceptions. How our "mind's eye" imagines the world both parallels our perception of the real world and illustrates an evolving internalization of implicit physical and mathematical knowledge (Shepard, 2001). Because of visual special effects, for example, we can illustrate and make concrete exactly how black holes appear to work, and illustrate abstract concepts as visible relationships through experientially oriented virtual simulations. Science not only requires visual imagery to explain its micro- and macro-worlds that lie beyond human visual experience, it also relies upon visualization as a creative process through which grand designs may be imagined.

This visualization process is creative both in the science learner and in the scientist as well. As the scientific genius Albert Einstein observed of his own mental images: "My particular ability does not lie in mathematical calculation, but rather in visualizing effects, possibilities and consequences" (Pinker, 1997, p. 285). Other scientists Pinker describes as thinking in images include Faraday and Maxwell, Kekulé, Watson and Crick. Cognitive psychologist Howard Gardner suggests that the creative mind works in images precisely because mental images allow us to understand one idea through another (1993, p. 365).

The union of Science and Image thus implies the use both of technological imagery to explore mind functioning, and of the mind's own pre-logical creative function in producing imagery that advances thought and makes imagination palpable and understandable.

### **The Power of Film**

Immediately after its inception as a technological phenomenon to capture a passing moment (as with Lumière brothers' *Train Arriving at the Station* (1895)), film soon became a vehicle for stimulating the imagination and making the never-before-seen real in a perceptual sense (as with Georges Méliès' delightful *A Trip to the Moon* (1902), complete with disappearingimps, chorus girls, and comic scientists). Neurologist Semir Zeki observed that "artists are in some sense neurologists, studying the brain with techniques that are unique to them, but studying unknowingly the brain and its organization nevertheless" (1998, p. 10).

Yet some forward thinking early film theorists understood perfectly well that film had the ability to alter perception, and therefore affect thought and attitude in profound ways. They understood the link between image perception and mindset and used film technology to quite literally alter the mind of the audience.

The great Soviet film theorist and director Sergei Eisenstein (1949, p. 62), for example, believed that the ultimate application of film montage was in propaganda, "Step by step," he tells us,

by a process of comparing each new image with the common denotation, power is accumulated behind a process that can be formally identified with that of logical deduction. . . [This] leads to the formal possibility of a kind of filmic reasoning. While the conventional film directs the emotions, this suggests an opportunity to encourage and direct whole thought processes as well.

The power to create and to direct thought, Eisenstein felt, lay in the dynamic energy of images juxtaposed in dominant counterpoint in time, space, line, place, volume and light. It was the perfect synthesis of philosophy, art and science—the ultimate integration:

The projection of the dialectic system of things into the brain, into creating abstractly, into the process of thinking, yields: dialectic methods of thinking; dialectical materialism—PHILOSOPHY. The projection of the same system of things, while creating concretely, while giving form, yields: ART" (ibid, 1949, p. 45).

In effect, in Eisenstein's view, film as art was able to create a perceptual argument for Marxist ideology and thus engage the viewer's emotion and direct his or her thought. Béla Balázs, one of the greatest film theorists, a director and scenarist who worked with Pabst and Riefenstahl, and an eminent teacher who worked with Eisenstein in the Soviet Film School in Moscow, also realized at once the power of film to influence the public mind and spoke eloquently of its potential:

We all know and admit that film art has a greater influence on the minds of the general public than any other art. The official guardians of culture note the fact with a certain amount of regret and uneasiness. But too few of us are sufficiently alive to the dangers that are an inevitable consequence of this fact. Nor do we realize clearly enough that we must be better connoisseurs of the film if we are not to be as much at the mercy of perhaps the greatest intellectual and spiritual influence of our age as to some blind and irresistible elemental force. And unless we study its laws and possibilities very carefully, we shall not be able to control and direct this potentially greatest instrument of mass influence ever devised in the whole course of human history (1970, p.17).

One might think that the theory of this art would naturally be regarded as the most important field for present-day art theory. No one would deny today that the art of the motion picture is *the* popular art of our century—unfortunately not in the sense that it is the product of popular spirit but the other way round, in the sense that the mentality of the people, and particularly of the urban population, is to a great extent the product of this art, an art that is at the same time a vast industry. Thus the question of educating the public to a better, more critical appreciation of

films is the question . . . of the mental health of . . . nations. Nevertheless, too few of us have yet realized how dangerously and irresponsibly we have failed to promote such a better understanding of film art" (ibid, p. 17).

While both Balázs and Eisenstein may seem to overstate the power of film in influencing an audience, it is well to remember that current scientific technology has confirmed the rather uncomfortable assertion that emotion guides thought rather than the reverse.

And although the good intentions of film directors and producers is often used to excuse the negative social effects of film imitation, in terms of perception, the intentions of the producer of the image is ultimately irrelevant in relation to the visual message itself. Neurological effects occur in viewers whether they are intended or not. Because neurologically, continually stimulating groups of brain cells makes them more sensitive and easier to activate (Carter, 1999), repeated neural firings with the same thematic or emotional content increase the likelihood of attitudinal and behavioral change toward conformity with the normal visual image. Like traumatic exposure, this realization has profound implications in terms of habitual media use and recurrent patterns of attitude and behavior within media, especially in interactive media such as video games.

Chief among neuroscience's contributions to the understanding of the power of the visual image to produce like states of mind and action in viewers is the detected presence of mirror neurons (mns) in the brain. What Social Theory research has revealed, neuroscience has deepened and broadened, establishing neurological research as the baseline for understanding human emotion, thought, action, and even social identity, primarily through a neurological process described as "intentional attunement" enabled by mirror neurons (Gallese & Migone, 2005).

Described as perhaps the most important finding of the last decade in neuroscience (Ramachandran, 2000), the discovery of mirror neurons has paved the way for understanding such diverse phenomena as the evolution of language (Rizzolatti & Arbib, 1998), emotional empathy in interpersonal communication, and personal social identity and coherence (Gallese, 2003). By establishing imitation as the chief means by which we learn, mirror neurons may ultimately prove to be the simplest and most direct route to understanding and addressing social behavior (Iacoboni et al., 1999; Gallese, 2000; 2001; 2003a, b, c; 2004; Gallese et al., 2004; Gallese & Migone, 2005).

The implications of mirror neuron functioning first became apparent when it was observed that in the Macaque monkey brain, a class of premotor neurons discharged not only when the monkey grasped objects, but also when it observed others executing similar actions. (Gallese et al. 1996; Rizzolatti et al. 1996a; Rizzolatti et al. 2001; Gallese et al. 2002). The same brain cells fired when the monkey watched humans or other monkeys bring peanuts to their mouths as when the monkey itself brought a peanut to its own mouth.

Concluding that mirror neurons could be the basis of a direct form of action understanding (Gallese et al. 1996; Rizzolatti et al. 1996a; Gallese 2000, 2001, 2003a, b, 2004; Gallese et al. 2004; Rizzolatti et al. 2001; Rizzolatti & Craighero 2004), researchers went on to find that mirror neurons could also be activated even when a major part of the action was hidden from view, or when sound alone suggested an action. (Umiltà et al. 2001; Kohler et al 2002). When the monkey broke open a peanut or heard someone break a peanut, the same cells fired. In addition to being observed in primates, mirror neurons have also been observed in humans, and even in some birds. In humans, they have been found in Broca's area, premotor and the parietal areas of the brain Rizzolatti et al. 2001; Gallese 2003a; Rizzolatti & Craighero 2004; Gallese et al. 2004).

Because the same cells have been found to function similarly in humans, whatever a person sees another doing may be experienced not simply vicariously through the imagination as a secondary process, but directly through a neurologically specific one. This means that, in the words of primary researcher Vittorio Gallese,

to perceive an action is equivalent to internally simulating it. This enables the observer to use her/his own resources to experientially penetrate the world of the other by means of a direct, automatic, and unconscious process of simulation (Gallese & Migone, 2005).

The virtual world of visual media, it seems, has as direct an influence on individual thought and attitude as actual experience.

Neurologically, without our consciously realizing it, emotional learning occurs that pre-frames attitudes, thinking, and behavior. Emotional templates serve as a basis for perceptual anticipation of the future, and although reason and emotion both play crucial and inseparable roles in perception, at various times, emotion can and does function at the expense of reason. Whether we select out specific movies because they resonate with felt needs and realities, or we make media choices based on cultural norms, it is important to realize that the emotional learning that goes with media experience is both unconscious and peculiarly indelible.

Neurological researchers today believe that mirror neurons are intimately and intricately involved in all of the complex behaviors that allow us to learn and adapt quickly within our social environment. Utilizing the mirror neurons system, we learn the most effective ways to achieve desired ends, and even to select what ends *are* desirable. Mirror neurons allow us to become attuned to culture and to other human beings in very specific ways, for better or for worse. In light of this research, a great deal of what has been trusted as reliable theory in the "soft" social sciences must be reconsidered and corrected.

According to neuroscientist Antonio Damasio, "images [i.e., mental patterns created through the senses] allow us to choose among repertoires of previously available patterns of action and [to] optimize the delivery of the chosen action" (1999, p. 24). Because the neurological maps that we use to navigate reality are drawn from the repetition of patterns of action provided by both direct experience and visual

media, the parameters of our behavioral choices are determined by both equally, using the same underlying neural mechanisms and mirror neurons.

Now sharing its power with other visual influences such as television and videogames, film still remains the premiere art form, its power enhanced rather than diminished by the pervasiveness of other forms of visual language. Because of this, Balázs's warning about educating the public to a better, more critical appreciation of films as a question of the mental health of nations has become even more significant, and the study of film as communication more, not less, vital in understanding and controlling "this potentially greatest instrument of mass influence ever devised in the whole course of human history." The basis of this study, as Eisenstein himself understood, is science. Without science, we cannot understand our visual world.

### **Visual Communication and Science**

Science is therefore a crucial component of all visual communication theory. Conversely, visual communication is also indispensable to science. Brains, it seems, were built to process visual images with great speed and to respond to them with alacrity. But they did not evolve to process written verbal symbols in the same way. "Brains were not built to read," Gazzaniga told us,

Reading is a recent invention of human culture. That is why many people have trouble with the process and why modern brain imaging studies show that the brain areas involved with reading move around a bit. Our brains have no place dedicated to this new invention" (1998, p. 6).

Visual information, however, leaks easily across the hemispheres through the limbic system and is unconsciously learned. This realization should put emotional processing of visual messages at the forefront of all visual communication research; it should also place visual communication as a priority in communicating scientific research to the public. Reading is essential to scientific research, but the chief means of disseminating knowledge and creating enlightened long term attitudes in the *public* mind cannot be through scientific literature. The science seems fairly clear: to reach the public mind, the easiest way is through the visual media. Like it or not, visual media governs a great deal of what occurs in the public mind, and attitudes about science are no exception. It may, in fact, be fair to say that the majority of what passes for information about science has been learned through watching *CSI*, *Oprah*, and a variety of major network morning shows. Attitudes toward scientific research, on the other hand, are often formed through the stories heard in church, and these stories are especially important to the future of science.

Research from the long-term Cultural Indicators Project initiated in 1973 at the University of Pennsylvania, for example, bears this out, and may show science the way to counteract false knowledge. Cultivation Analysis Theory, which crystallized from the project, has concentrated on the storytelling function of media, and focused on the developing patterns of attitude that neurological researchers have found to be the basis of unconscious emotional learning:

We live in terms of the stories we tell—stories about what things exist, stories about how things work, and stories about what to do—and television tells them all through news, drama, and advertising to almost everybody most of the time (Gerbner Gross, Jackson-Beck, Jeffries-Fox & Signorelli, 1978, p. 178; 1980).

Since in reality there is no more important or fascinating story to tell than that of science, it seems essential that scientists themselves begin to see the importance of visual storytelling in educating the public mind, and to actively use visual media as a means to establish an awareness in the scientific classroom of what things exist and can exist, and to tell real stories about how things work and how they will evolve. Clearly the public has an appetite for science, but predominantly commercial interests have filled the vacuum, mostly with fantasy or inanity.

Some suggestions made by collaborating scientists and visual researchers (SIGGRAPH Eurographics Colloquium on Visual Learning in Science and Engineering) for developing visual thinking within the discipline have included: urging scientists to find ways to articulate and interpret the nuances of visual worlds, to work toward better collaboration across disciplines. Additionally, it is recommended that all science and engineering students have some exposure to creating visualizations; that any science program should begin with a firm grounding in visual theory and practice from an intuitive and experiential perspective. Pedagogically, because lecture alone is the least effective way of reaching the whole learning being, learning should be structured so as to engage as many of the senses as possible and allow students to explore, engage in, and visually complete the meaning of scientific concepts.

## **Conclusion**

A quarter of a century ago, Roger Sperry, in his Nobel lecture, saw a confluence between science and the humanities which has truly yet to be realized,

Where there used to be a chasm and irreconcilable conflict between the scientific and the traditional humanistic views of man and the world, we now perceive a continuum. A unifying new interpretative framework emerges with far reaching impact not only for science but for those ultimate value-belief guidelines by which mankind has tried to live and find meaning" (Sperry, 1981).

There is no simple way to counter resistance toward science as a foundation for thought in the humanities; or to convert scientists to visual ways of thinking; or to inspire some to leave the laboratory for the studio. But seminars like this one make a start.

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**Museum predicaments:  
(Re) Considering Institutional Forms and Controversy in Global Risk Society**

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*This research suggests that relationships between museums and audiences in the engagement of controversial topics require a new account of self as a symbolic project that is self-acting, more open-ended and reflexive. According to 80% of audiences surveyed, institutions are seen as having the power to challenge people's ways of thinking and shift an individuals' point of view.*

**Introduction**

Controversial topics, their relevance and place in the museum, go to the heart of the roles and purposes of the museum project in an increasingly complex and globalising world. Controversy is no longer something to be feared, but signals the contemporary relevance of the museum form in public political culture. In this paper I argue that engaging controversial topics and science controversy is a natural social form. I propose that museums have a critical role in activating controversy as a productive mode of engaging their audiences, in formulating new knowledge and in contributing to debates and decision-making within wider public political culture. I also illustrate how institutions might innovate to engage controversy in a world increasingly characterised by global risks and hazards.

The idea that museums *should* engage science controversy is strongly supported by the findings of the Australian Research Council funded international research project, *Exhibitions as contested sites: The roles of museums in contemporary societies*. Our research involved qualitative and quantitative research, phone and exit surveys, an online industry survey, and focus groups and interviews with staff, stakeholders and audiences involving 28 institutions in the US, Canada, UK, Australia and New Zealand. The findings from our phone interviews in Australia say that 60% of those surveyed and around 80% of museum visitors interviewed in five museums in Australia and Canada stated that engaging important challenging and controversial topics, and points of view in a democratic, free-thinking society for many was seen as a key role for museums– one of the few places where these debates can happen.

*It's the role of museums to be provocative, to bring certain things into question and under consideration (Sydney Pulse, female pensioner).*

*There are few places in our culture where people dare to take on such issues to force us into a new paradigm (Contested Sites, Museum of Anthropology survey).*

These sentiments were supported by our online staff survey, (albeit a self-selected sample) with 89% of museum staff, agreed that museums *should* present exhibitions about topics that some people may see as taboo or controversial.

*Museums can provide the perfect setting for discussions and debate around topics that directly influence and shape society* (online survey, museum staff, USA).

### **'Hot' topics**

Our research with museum staff, stakeholders and audiences suggested that the key factor in engaging controversy were the choice of the topics themselves. This related to their currency, their ability to polarise people, and engage political sensibilities. In focus groups, museum staff and stakeholders we identified a number of topics as being controversial or potentially controversial. These often differed from institution to institution, and from country to country, with some broad trends emerging

### **The USA**

In the USA for example, museum staff we interviewed identified six topics as being potentially (or actually) controversial. These included scientific topics that confront people's ethics or beliefs (such as evolution, animal rights, and biotechnology); issues of national identity as it relates to ethnicity or race relations; the idea of an unpatriotic national identity – in other words, 'any topic that presumes to criticise America for anything' (Contested Sites Staff Focus Group Transcript USA); issues that are perceived to be about morality (such as abortion rights, sexual identity, and drugs); different perspectives of history (including indigenous histories and women's histories); and finally, terrorism and the war against Iraq, together with related subjects such as Islam. These topics reflect an uneasy tension between the rights of the individual, allegiance to the authority of the state and the church, and America's relationship with other nations or peoples in terms of current world events and politics.

The main concerns of staff and stakeholders about exhibiting these topics related to the fear of losing funding support; the need to be politically correct in order to receive and maintain public funding; the risk of alienating stakeholders or lobby groups; determining who's voice and history is told; and the risk of having the museum hijacked as a platform for people who have opinions about that topic. These tensions were counterbalanced by the perceived need to remain relevant, to take an active and important role in contemporary societies,

*If we are content to be pretty places that tell safe stories we will quickly become relevant and then really be at risk of losing our funding* (online survey, museum staff, USA).

Audience's concerns were mainly directed towards the potential politicisation of institutions. Undermining institutional legitimacy and trust, according to those we interviewed has the potential to occur when museums present unsubstantiated opinions and openly engage in a partisan debate.

*It would turn [museums] into a different institution altogether if they were trying to lead public opinion...that would border on political (Contested Sites Visitor Focus Group Transcript).*

Although it is clear that both institutions and communities see museums as having a vital role in the engagement of controversy, and many institutions are indeed tackling 'hot' topics, there exists an uneasy tension between how to negotiate their institutional settings; a lack of clarity about their roles and responsibilities; how to position themselves around controversial topics; larger concerns around the potential incompatibility of existing institutional forms; the need to (re)invent new ones to remain relevant; and to maintain perceived legacies of impartiality and trustworthiness.

The second part of this paper interrogates these blockages and proposes with greater clarity drawing on contemporary cultural theory and empirical data, ways that institutions might (re) formulate their roles as actors and arenas to better embrace controversial topics and controversy in light of emergent social conditions.

### **Global risk society – a new optic for (re) conceptualising controversy and museums**

Ulrick Beck's Global Risk Society (Beck 1999), Manuel Castell's (1996) network society, Zygmunt Bauman's (2007) liquid modernity, and John Urry's (2003) global complexity are all theoretical paradigms that interrogate contemporary social conditions operate as an optic to critique the museum project, consider current programs and (re) frame museums roles in a world characterised by global risks and hazards.

Central to Beck's idea of global risk society is the concept of risk. Risk, its forms and means of control I argue, acts as a unique entrée into a critique of the modern museum, how controversy is viewed and managed as part of this project and offers a way of articulating new formations for controversial engagement in contemporary museums.

Risk is deemed the key motivator in the transformation from first modernity - national industrial society and its social forms based on territorially defined collective patterns of life, the family, the welfare state and the union, the exploitation of nature and the idea of technological and scientific progress to new articulations of society defined as second modernity - contemporary global society (Beck, 1999). According to Beck (ibid) risk is a modern approach to foresee and control the future consequences of human action and the various unintended consequences of modernisation. Risk predisposes decisions. It operates in an immaterial form as mediated and contested definitions of risk, both real and imagined in the private consciousness of individuals and public consciousness of society, and in a material form, as manufactured by experts and industry worldwide.

The articulation of new social forms is just one element, the other are the bases of contention and justice - the former being the distribution of scarce goods or wealth

through class and unionised struggles, to one based on the distribution of 'bads', risk and hazards such as climate change. The latter is important in articulating new interventions around risk human rights for museums in an increasingly politicised global risk society. Topics deemed controversial and those identified as part of the research such as genetically modified foods, biotechnology, war, terrorism and environmental degradation are necessarily part of the structure of risk conflicts articulated around competing definitions of risk and their various material forms.

The risk regime of modernity is conceived as an objective entity one to be controlled through calculation, assessment and probability (Powel, 2007, p.70). The sociology of risk promotes the establishment of control and preventative mechanisms such as expert knowledge systems, museums, the police, government and insurance. These institutional forms are inseparable from the politics of risk - real and perceived threats to our fundamental political ideals of liberty, justice, rights and democracy.

### **Museums as institutions of first modernity – institutional forms and controversy**

Museums for example were established as institutions of first modernity. They were conceived as places to control risk by monitoring cultural conversations, to educate by setting moral standards, by reforming behaviour, and by producing responsible citizens (Bennett, 1995; Cameron, 2007). They were framed to celebrate science and technological development promoting a radical optimism and certainty about the future by producing knowable, certain expert knowledge. Expert systems of knowledge based on scientific objectivism promote the former, while social recognition of other forms of knowledge cast as lay, have been withheld. The individual is conceived as a unit within society, disciplined and shaped through an educational lens according to the mores of the governing classes (Bennett, 1995). It is therefore not surprising that controversy has no place and is indeed incompatible with this institutional formation, given the emphases on authority and discipline, the collective and audiences as objects of governance, and the exclusion of the non-expert voice. The legacy of this form was expressed by one staff member at the National Museum of the American Indian

*we do very well at being intellectual bastions; we don't do very well at giving social experiences...if we become better social experiences we may be more able to deal with controversial topics (Contested Sites Staff Focus Group Transcript).*

The reworking of the museum idea in the 1980s, in philosophical terms as the new museology, and in practice as the forum for debate (Cameron, 1971) offered new hope in the representation of difference and contention. However, this model is posited on the idea of the ontology of difference and the representation of gender, ethnicity and so forth. Pluralism and diversity tends to act as separate non-interacting entities to describe the subject and represent the whole, for example a cultural group or a community. Within the forum, museums are still reluctant to admit non-expert knowledge and contention as a core theme except on the periphery.

### **The erosion of first modernity and the museum project**

The erosion of first modernity, the museological project and the incumbent need for new institutional forms around controversy is driven by the unintended consequences of the success of industrialised society. That is, the emergence of hazards and those deemed as potentially threatening such as the degradation of the environment and climate change; terrorism; nuclear accidents; global financial meltdowns; threats to food supplies; genetically modified foods; BSE; cloning; infectious diseases such as HIV Aids along with the effects of globalisation, individualisation due to neo-liberal policies (placing a new emphasis on the individual as responsible for their own self-interest, self care and self-help) and reflexive modernisation (the self-critique of modern society).

As these manufactured risks become prominent and are made objects of expert, public and personal concern, the failure of expert systems to manage uncertainty and calculate risk precipitates a public breakdown of trust in science, corporations and government. This leads to doubt, uncertainty about the future, insecurity, instability and the emergence of new dialectics of conflict over the distribution of 'bads', risks or hazards. This is most evident with climate change. Unintentional and in the shadow of global dangers and uncertainties, society opens to the sub-political. That is, the rise of the concerned and responsible individual globally networked sub-political movements (outside representative government), trans-national institutions, the emergence of discourse coalitions and opening up to the possibility to alternative knowledge systems. Individualisation, scepticism and diversity become written into society. These social and institutional forms and methods of engagement according to Beck (1999, 20) signals the "emergence of a new kind of capitalism, a new kind of economy, a new kind of global order, society and personal life".

The theoretical orientations of Castells (1996), Bauman (2001) and Urry (2003) more clearly articulate what these social and institutional forms look like particularly in terms of the use of digital technologies in shaping global society, one in which Beck fails to address. Castells (1996) describes contemporary society as an ontology of network cultures, as a new social morphology that substantially modifies the operations and outcomes of processes of production, experience, power and culture.

Bauman (2001) uses the analogy of a transformation from a solid structure to liquid forms. According to Bauman's thesis, solid frames for structuring human actions give way to a networked society, a matrix of random connections and disconnections of an infinite nature on which endemic uncertainty prevails. These fluids according to cultural theorist John Urry (2003) are partially structured by the various scapes of the global order, the networks of machines, technology, organisations, texts and actors that constitute various interconnected nodes along which flows can be relayed. Here societies are lying truly wide open, materially and intellectually, impotent to decide its own course with any degree of certainty. The erosion of the museum project is clearly evident in these liquid network formations. In these new formulations of global risk society, boundaries between the museum and the social space of lived experience are erased. The

unmanageability of contemporary threats particularly in the world of Web 2.0, and the internet - a medium that promotes debate and citizens as producers - questions the validity of risk-regulating institutions such as museums, and their ability to limit and control danger, to regulate cultural conversations, to act as moral and reforming technologies around hot topics, and to act as authorities in promoting social mores. For example museum collections data is being appropriated in social networks for political purposes outside the ambit of the museum. Via Google, collections of Persian objects, used as signifiers of Iranian cultural identity were mobilised to counter negative representations of ancient Persia following the 300 movie controversy about the battle of Thermopylae between the Persians and Spartans in 480BC (Jones, 2007). Searches for the film *300* were diverted away from the film to a website Project 300 that displayed contemporary Iranian art, documentaries and links to the British Museum's *Forgotten Empire* exhibition of Persian artifacts (ibid, 6). Art works were used as a tool to project positive representations of Persian civilisation and bolster contemporary national narratives.

The risk regime has changed. As industrial projects and their incumbent and perceived risks become political, institutions become part of this new structure of risk conflicts. Museums as contemporary places where science and society meet require a consideration of new social relations. Moreover, as people reflect on the bases of democratic, national, economic model of first modernity and examine their prevailing systems for example, museums as spaces for promoting scientific and technological development, they too become the subject of critique.

The museum form of second modernity and its role in risk management and agency in the engagement of controversial topics therefore necessarily takes a new turn. Embracing these new risk contexts can be viewed as a bold initiative. Beck suggests that in this age of uncertainty and ambivalence with constant threats, be it disasters, events or debates, we need to re-invent our political institutions and new ways of conducting politics at social sites previously considered un-political. Beck suggests that there are three responses to risk: denial, apathy or social transformation (Ekberg, 2007). Clearly to embrace risk in all its uncertainties, museums must think and be organised differently.

### **Museums, risk regimes, and as institutions of second modernity**

So according to my own assessment of Beck, Castells, Bauman and Urry, and drawing on the research findings of the *Contested Sites* project, what might the institution of second modernity look like and how might this inform ways to more meaningfully engage controversial topics and science controversy given shifting social conditions and circumstances?

***Life politics, global risk biographies and the self-interested visitor.*** One of the key social forms in second modernity is the notion of individualisation. Here and within the museum the individual is reshaped from solely an object of discipline to one that is also reflexive, political and driven by self interest. The use of museum information in the formation of biographical details is evident in this response by a visitor to the Canadian War Museum, and typical of many others,

*Museums give a non-biased view of events and issues and allows people to form their own opinions (Contested Sites Canadian War Museum survey).*

Focus group research clearly shows that the loci of responsibility for engaging with controversial topics and for reform, remains with the visitor through the development of their own biographical solutions. So how do these biographical processes operate around controversial topics, and where are museums positioned in this process? For around 25% of focus group participants, museums act as spaces for *historical reflexivity*. They are places to gain information on 'hot' topics and events in the historical record. Audiences use this symbolic content to look and learn about the past by engaging their own capacities for inner reflection and to evaluate their own values and beliefs.

*Museums are reflective, there is ...an opportunity to reflect on the past (Contested Sites Visitor Focus Group Transcript ).*

This is likened to media theorist John Thompson's (1995, p.42-3) analysis of media content. He argues that audiences appropriate messages and make them their own in a process of self formation and self understanding (ibid).

For the majority, 55%, contextualization acts as a reforming tool. Applied to current as well as historical topics and events, this approach enables audiences to understand their origin, complexities and likely ramifications,

*with September 11 and the Bali bombing for example, a museum's role is to build up a historical picture of where these events originate (Contested Sites Visitor Focus Group Transcript).*

Symbolic content is deployed for locating, constructing and reforming self, understanding others, in reshaping stocks of knowledge, testing feelings, attitudes, re-evaluating moral positions and expanding horizons of experience,

*It is important to get some reference to where you sit in the scheme of things - where is my place in all this (Contested Sites Visitor Focus Group Transcript).*

It resonates with diagnostic reporting by deconstructing problems, analysing causes and in portraying the context in which the story is taking place (Alagiah, 1998, referenced in Tester 2001: 39).

For around 20%, reform referred to activist agendas, and the involvement of an active re-shaping of an individuals' behaviour to bring about change. That is, by opening people's minds to alternative views on a given topic and offering suggestions on how audiences might become active to bring about change,

*If museums are to continue to exist as people friendly institutions, they have to have programs to educate people about the history of terrorism, why it*

*happens and the role of civil society to combat terrorism (Contested Sites Visitor Focus Group Transcript).*

Here symbolic content acts with self to interrogate choices, motivations and frame action,

*I like the idea of an exhibition being empowering – in presenting good ideas and how do you turn that into action (Contested Sites Visitor Focus Group Transcript).*

This research suggests that relationships between museums and audiences in the engagement of controversial topics require a new account of self as a symbolic project that is self-acting, more open-ended and reflexive. According to 80% of audiences surveyed, institutions are seen as having the power to challenge people's ways of thinking and shift an individuals' point of view. The means of constituting and reforming self, however, refers to a greater ability to self regulate, evaluate and process a range of information on their own terms,

*museums should not express an opinion, they should provide good information and arguments...We have our own opinions (Contested Sites Visitor Focus Group Transcript).*

But how can institutions innovate further to allow their audiences to be more politically reflexive around science controversy? This represents a shift from the moral individual, to rights to knowledge and to have a say in risk management. Given that reflexive notions of the future and hazards disrupt and critique science and technological notions of progress and forms of rationality, how can institutions facilitate involvement in decision-making and discussions about scientific research and technological development in an unknown and uncertain future? And how can institutions move beyond the individual as a locus of responsibility in terms of choice and burden, to one of collective individualism, and critique and challenge government, industry, business and science, the agencies from whom sources of risk tend to originate? The allocation of risk, in which science controversy is a central theme, suggests a new political project for museums in terms of risk conflicts and in building trans-national risk communities.

**Engaging risk conflicts.** Given that risk conflict and conflictual co-existence are central elements of global risk society how can institutions re-position these dynamics at the centre of the museum while maintaining institutional legitimacy and trust? The Contested Sites findings suggest that for 90%, this is tantamount to offering opportunities to express their opinion,

*everyone should have the opportunity to express their political view whether others agree with it or not (Contested Sites Visitor Focus Group Transcript).*

For others it also involves engagement with other visitors, the institution and the ability to leave evidence of debates in exhibitions,

*with more discussion, people would be better informed and therefore form their own opinions (Sydney Pulse Report, 20).*

Clearly museums have a role in the staging of self culture – the cultural and political dynamic of one's own life. So how can institutions move beyond the individuals own expression of opinion and as the moral activist, to facilitate opportunities for other forms of political reflexivity through engagement with sub-political movements, in building shared communities of risk in a trans-national contexts through direct action?

***Discourse coalitions and reflexivity.*** In these new risk contexts museum expertise is reformulated. The findings from the Contested Sites project show that museum information is still highly respected and influential,

*museums have a reputation like university professors, and you expect to see things which have the backing of scientific method. It is not just some ratbag sprouting propaganda, it's a well thought out established viewpoint.*

While still seen as trusted, respected and more informed in a world of uncertainty, their struggle for primacy has been largely lost. Museum expertise becomes just one of the many narratives that operates with others as part of discourse coalitions in public debates, albeit a very important one in framing self culture,

*Museums could present lots of different views that call into question people's views (Contested Sites Visitor Focus Group Transcript).*

To this end reflexive strategies become paramount both in terms of the institution as self critique and in the interpretive framing towards informing self. For 70%, this involves techniques that facilitate critical thinking. That is, through carefully selected and authoritative scholarly information, multiple perspectives and opinions on given subjects, source transparency, interpretive guidance and the framing of content to show how judgements are formed and decisions made. Clearly this represents a reformation of the notion of institutional trust to one of active trust firmly based in the concept of self culture. It is premised on the notion of dissent, rather than consensus, and rests firmly on the recognition to the rights to 'one's own life'.

***Nodes in global networks: trans-national institutions and risk human rights.*** In second modernity the public fora is (re)written on the basis of a new ontology of institutions as nodes in fluid networks where the value of communication and interaction rather than the ontology of difference as explained in the earlier discussion. The ability to link, embed and connect museum information to public culture debates and harvest information from a range of sources is enhanced via Web 2.0 and with the emergence of social spaces such as MySpace, YouTube, Flickr, Facebook and Second Life. Museum information now operates in fluid, global networks connected to other social, political, cultural resources and agendas. These contexts in which people more easily become content producers, interact with, share information, engage in social action and

participate in social networks pose a series of new risks and opportunities for museums - the latter to reconnect with public culture debates and build communities around risk human rights. Clearly when considering museum-public culture interfaces there is a move from museum hierarchical organisational forms as separate, and standing above society, to ones that are more flexible, open, dynamic, relational and interactive that operate as nodes in networks able to connect with other resources. New roles emerge as museums operate as attractors in a network bringing various elements, ideas, people and different types of interactions together, and as a border zone where different systems of representation meet.

### **Conclusion**

So using Beck's thesis, what would museums as an institutional form look like, and how might institutions engage global risks such as climate change in new ways? Here an ethos of risk and uncertainty holds the potential for renewal and the development of new institutional forms, where museums are conceived of as complex, open systems, as part of networks in global flows, as platforms for interactions along with the idea of the politically reflexive, active, citizen.

One of the key themes is the intensified responsibility placed on the individual to define themselves, make choices and decisions about their lives in order to form their own biographies. In the past institutions were involved in shaping and reforming the individual by prescribing moral standards and forms of behaviour. Now institutions need to assist the 'self interested' visitor in forming, planning and designing themselves as individuals on their own terms. The moralising and reforming frame might be conceived of as more self-acting through the production of information in a way that facilitates critical thinking and self action.

The notion of expertise and risk definition needs to become broader, away from a solely scientific and economic perspective to one that engages culture and their competing definitions. Our research suggests that expert systems as knowledge resources such as museums are still important. There is however, a need to acknowledge that museum expertise operates as one group which interacts according to their own rules along with others, creating their own properties and knowledge in the cultural order. Museums in a complex system can be conceived as a thought collective – part of a group performance along with other agencies for mapping out the social world around a given issue or event.

New modes of trust now exist in a contemporary risk society. Because reflexive individuals form trust relationships based on mutual, reciprocal and active trust rather than trust that is passively accepted as in the past, institutions need to build on and reframe this trust relationship by adopt a more open, flexible and less hierarchical style of engagement and interaction, through reciprocity, exchange, dialogue and decision-making. Controversy is seen as productive, as a means to generate and gather together a range of views around a given subject, rather than something to be controlled and minimised, as an expression of an individual's self politics.

The museum sector has the opportunity to take advantage of networks and capitalise on their variability, interconnectivity and intercommunication as a means to contribute to contemporary debates – as trusted and respected information sources. There is an opportunity to view museum information as cultural and economic capital that can be used to activate, and contribute to discussions, gain currency and strengthen public-museum culture links. This might involve actively embedding museum information in debates, i.e. blogs and social spaces, and also harvesting information from the outside i.e. news feeds etc into the museum space.

New political forms emerge according to Beck's thesis. Here institutions might consider how they might become part of sub-political movements and define what their interventions might look like within new political formations.

Climate change risk for example has the potential to build trans-national communities and networks, and to activate a cosmopolitan imaginary. The seeds of these transformations can be seen with the Climate Change Youth Forum at the Natural History Museum in 2006 and the IGLO initiative. In a networked form, museums can operate as nodes in fluid networks and flows of information, people and resources and contribute to building communities by promoting public awareness of risk and by activating and connecting with others across borders over shared risk.

The advent of sub-political formations enables institutions to build new alliances with NGOs, experts and other grassroots movements as part of these new political constellations. The question is where might they fit in these formations for example, providing much needed information on climate change risk for example, connecting, networking, building alliances, developing forums for shared perceptions of risk, challenging the agendas and policies of government, corporations and so forth. Institutions must also become self reflexive, to critique themselves and make their positions transparent.

Museums may have new roles in risk human rights, that is, rights to information about risk and to participate in decisions with trans-national impacts. This could include the creation of trans-national connections to activate discussions about risk allocation and inequalities in people's risk positions.

Perhaps institutions have a role with other agencies in public political culture to activate and broker cross-sectoral discussions and decisions with government, business, industry and communities around the larger systematic shifts about post-carbon futures for example. The focus politically is on the carbon economy and protectionism, rather than looking to the longer term about how we want to live. Sub-political movements of people developed out of climate change risk made public, can pressure these coalitions to bring about change and to collectively imagine an unknown future.

Institutions may have a role in networks for direct action and trans-national protest by activating discussions, mobilising people, providing links to a range of information, acting as mobilising points. They may have a role in contributing to

the socialisation of risk across generations helping people to define their own biographical positions about what an imagined future might look like.

Some of these ideas are utopic. Potential interventions will vary between institutions. The challenge is to reconcile institutional forms and museum-public culture interfaces with the political settings institutions operate within.

The institution of second modernity heralds a new era in museology. This process of transformation and research into interventions and institutional forms as part of global risk society is the focus of a newly funded ARC international grant "Hot Science Global Citizens: the agency of the museum sector in climate change interventions." The findings to inform this transition will emerge over the next three years.

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## **The Inconvenience of Truth: Rethinking the Agency of Science Film Spectators in a Post-Postmodern Era**

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*The spectator of science's advancement in the postmodern world is a viewer who gazes upon the world with full cognizance of the mixed bag of gains and losses, risks and benefits, entailed in scientific and technological advancement. We no longer can regard the audience of the science film to be composed of innocents or naifs in need of education about true facts, or about contextual impacts.*

### **Introduction**

In the Spring of 2007 I served as a juror for the 43<sup>rd</sup> International Festival of Popular-Scientific and Documentary Films Academia Film at Palacky University in Olomouc, an ancient Moravian city of 100 thousand whose town square still houses speakers used by the Soviet-era Czech government to broadcast state propaganda each evening. A formerly isolated and technologically under-developed university town became a hub of high-tech international media, with journalists, filmmakers, and web and television newscasters accessing WiFi from the cafes and university offices that filled the baroque and gothic buildings along the narrow cobbled streets of the city center. Jurors and visiting filmmakers ranged from figures in science film production during the Soviet era to contemporary graduate students from post-Cold War former Soviet bloc countries training in the US as well as at home. The group, and the ethos of the festival, was transgenerational as well as international, intercultural, and formally and esthetically wide-ranging. There was a lot of excitement about the science film as a genre that was seeing widespread international attention after the successes of films such as Al Gore's *An Inconvenient Truth* and the visually lush science large-screen films of the 2000s (such as *The Deep Sea*) that benefited from advances in digital production and exhibition technologies of the 1990s digital boom.

At this science film festival I screened DVDs of hundreds of submissions of popular and niche-audience documentaries produced around the world in the previous few years. Unsurprisingly, there was a preponderance of graphically striking films about science and globalization, most of them linking together the themes of climate change, global warming, the oil and natural resources industries and the alarming rates of consumption among westerners, global industry and trade expansion, population explosion, and the impact of globalization on indigenous agricultural practice and the planet in general. These films had in common an impressive range of footage from around the world, and shared the goal of educating western spectators about the global crisis in natural resources and the unsustainability of our current production and consumption practices. All of these films had in common as well the use of voice-over narration (in most cases male) delivering, along with sobering facts and alarming footage, all driving home the message that viewers

should be aware of the deep and irreversible costs of technological advancement and globalization.

What struck me most about these films was the fact that most of the audiences to whom they were geared already knew about the circumstances they narrated. The apparent goal of these films to educate viewers about the environmental, demographic and human impact of technological advancement and economic and industrial globalization was lost, I felt, on an audience already well aware of the crises enumerated, but less clear about options with regard to the paths of action citizens might take to address these crises effectively. The circumstance I sensed in relationship to these films was well captured by a science journalist I heard interviewed on National Public Radio months later. The journalist was asked the question: what can we do to avoid the train wreck looming ahead in light of multinational industry's impact on the environment and on the poorest nations and peoples? He paused and then quipped,

*"Well, the train wreck has already happened."*

It occurred to me as I listened that this remark was probably not received as a new fact by many listeners besides myself. I interpreted his pause to be due to his momentary incredulity that the interviewer could even imagine that there might be time left to change the course of globalization's impact. More accurately, we might say that we all know that little and big train wrecks are happening in incidental ways as we go about our everyday lives, in a kind of on-going way that we no longer really notice for long, any more than we really notice for long the wreck moved off to the accident inspection site at the side of the freeway during our evening commute. We cannot turn back the clock. I was reminded of my experience sitting in small audiences of students, journalists, and filmmakers from around the world watching film after film about climate change, medical findings about the western diet, and human sexuality—all of them presenting to us information we more or less already knew. The apparent goal of these films was not only the modernist goal of imparting knowledge--to educate us about scientific advancement. It was also the postmodern goal of getting us to see the contextual factors that make scientific knowledge do the work of helping us to interpret and live life meaningfully in the everyday world.

But in watching these films, and in hearing the NPR commentator's quip about living in the wake of the train wreck and not in its anticipation, I find myself realizing that we no longer live in that postmodern moment in which knowledge is power. The Internet and the Web have contributed to a situation in which most of us that watch these films, at whatever age, already know the facts. Moreover, most of us who see these films are aware of the contextual circumstances and effects of scientific and technological research, development and practice. As science educators, we need to face up to the fact that we are dealing with a public that is already in the know. We live in an era that has moved beyond the postmodern ethos of already-knowing. Moreover, we are shortchanging the public when we offer films that point out the wrongs and ironies of facts about the world such as the impact of industrial and technological development. Our task, I propose, is to make

films that offer options to viewers in their quest to figure out best practice in everyday life in the midst of the on-going wrecks that accompany the gains of science; to minimize long-term impacts and to mitigate damage.

### **Audience and knowledge**

The biggest problem that faces producers of science films today, I propose, is how to engage the science film spectator in a project of engaged action despite the fact that the spectator is a knowing, even jaded, subject of science. The first step in this challenge, I further propose, is to determine where the spectator stands in relationship to scientific knowledge and practice. Is he or she merely a spectator, an observer of expert practice and a recipient of expert knowledge, who can give voice to opinion through the democratic process? Contemporary relationships of knowledge and power no longer take the form of a top-down science in which the consumer imagines him- or herself as recipient of the benefits of science, medicine, industry. Rather, the consumer-spectator is more likely to see him or herself as implicated ambivalently in the democratic practice of science, as someone with the right to a say in things that may hold both risks and benefits.

At the same time, the contemporary consumer-spectator sees him- or herself as one who witnesses—that is, one who looks out onto the world of science in breathless awe from afar, whether that experience is produced through gazing upon Disneyfied distant wonders (*Roving Mars*), to vicariously witness the conquest of nature (*Everest*), or to gasp at the unthinkable impact of big industry on small communities (Channel 4's *The Drilling Fields*, an exposé of Shell Oil). Let me use a filmic metaphor. We watch the impact of industrial globalization and the scientific and technological transfer that accompanies it knowing full well that even as we celebrate the gains that come with technological, medical, and scientific advancement, these changes bring other changes that can only be described as tragic for the environment and for human life. But we—meaning all of us, the lay public, filmmakers, scholars, and scientists alike—look out at these changes as if they are occurring on a cinema screen. Witnessing is a kind of drive-by consumption of science in action. The impact we witness is indirectly felt—is *witnessed as if from afar*, even when the impact is direct and as-if up close (an experience the IMAX experience is designed to give us). Even as we watch the benefits of technological and scientific advances, enjoy them, we just as quickly feel those benefits reverse themselves as we witness someone else paying the price (those living in the midst of Shell Oil's waste pools, for example) or as we find we can no longer pay the price (at the gas pump, for example). We see globalization's surge forward and its reversal as if from the distance afforded by the cinematic screen.

### **Engaging the audience**

The challenge thus becomes how to engage a consumer-spectator jaded not only by knowledge of science's truths, convenient and inconvenient alike, but by the fact of distance that characterizes most of the contemporary issues and practices that come to light. What, we might ask, is the next step after witnessing, and how might science films foster that step?

To put this another way: The spectator of science's advancement in the postmodern world is a viewer who gazes upon the world with full cognizance of the mixed bag of gains and losses, risks and benefits, entailed in scientific and technological advancement. We no longer can regard the audience of the science film to be composed of innocents or naïfs in need of education about true facts, or about contextual impacts. There is little we can tell our everyday audiences, from the 8 year old shown *An Inconvenient Truth* at school to the 80 year old grandparents who grew up crop-dusted well before Rachel Carson's awakening of a liberal sector of the American public. These spectators know the truth about their experience, and face the science documentary today with a jaded eye. But the jaded spectator loses interest. We have to offer some means of bringing the jaded postmodern spectator into the action of science.

The question for science documentarists thus becomes: How do you educate a knowing spectator to the point of imparting agency and the ability to act? What is it that we want spectators to do with the knowledge they take away from a film? Is it knowledge that we wish to impart, or something more? What approach do we take in the education of viewers who must learn how to live in the mundane circumstance of the contemporary environment, in which wondrous cures and amazing feats of communication are accompanied by rising rates of cancer, poverty, illness, and economic crisis for the many on a global scale? With the heady era of trade liberalization and the collapse of distance past us, we now live in an era when we all know that distance costs money, and that scientific advancement is never without significant costs close to home. For the spectator of the 21<sup>st</sup> century big-screen science film, then, there is no going back to a purer place for science in the public imagination. There is no wonder untouched by the awareness of the costs of scientific gains. Nature is a spectacle to be consumed always at some alteration to someplace, or someone.

To return to the science films I viewed in 2007: Although I found the goals of the many science films about global warming and industrial globalization laudable, and their formats persuasive, I also felt invited by them into a frenzy of social outrage that required of me a realist response to truth claims. These were not the truth claims of science so cogently attacked by postmodernists in the science wars—the critics who argued that science's foundation in truth claims ignored the social relativism of any construction of truth. Rather, the truth-claims of the new wave of science documentaries were in the direction of truths one could surmise only through critical analysis, and only through interpretive tools that allow us to see science in social context. Although I am more than happy to back this notion of truth as contextually produced and contextually impacting, I am left wondering where spectators can be expected to go with such inconvenient contextual truths. Critical consciousness on its own leaves no opening for compensatory or mitigating action. These films left me with no blueprints or guidelines for social action. In the end we awarded the top prize to a film about the philosopher Slavoj Žižek, a film most of us saw as not really about science. This was simply because at the very least this film saw the global circumstances in which knowledge and information alone left viewers with few options for seeing themselves as agents of action.

## **Rethinking the science film**

The agenda I want to propose, then, is to rethink the model of science as the domain of expert knowledge, and the public as a body of citizens in need of education and information. Rather, I propose that we consider the science film spectator as a potential actor with agency, and the science film as a means of generating something beyond a change in consciousness.

This proposal begs the question, how would one impart agency to viewing audiences? My first suggestion is that the producers of science films drop the tired conventions of voiceover narration as the locus of authority and take up the strategy of distributing voice among a wider range of constituents, including those for whom films are intended. I look, for example, to the successful audiovisual ethnographies of Richard Chalfen of Temple University, who participates in hospital programs designed to increase patient compliance in asthma treatment. Chalfen engages patients in a program in which they participate in the production of media texts that informally document on video the day to day treatment experience in the home and clinic. These tapes are then viewed by doctors and caregivers, who can learn from them exactly how it is that the patient experiences his or her treatment regimen, and why it is that some methods—and some drugs protocols--just don't work.

Another example is the Global Tourette project by science digital media producer Brian Goldfarb, a professor at the University of California at San Diego who has retooled hundreds of disposable video cameras, placing them in the hands of youth with Tourette syndrome and their family members and caregivers. The home videos they produce, in addition to media they produce in animation workshops geared toward maximizing behavioral traits associated with the disorder, are woven together in documentaries with the goal of providing the public with an awareness of the diversity and variability of Tourettic experience, rather than imparting truths about the condition from expert to novice or lay public. As in the case of Chalfen's documentaries, the Global Tourette films are used by doctors to get a glimpse at the everyday performance of youth with Tourette who are expert at masking symptoms in the clinical setting.

## **Conclusions**

This brief set of examples and suggestions is meant to open up some new doors for those who work within the genres of science as spectacle and science education. We must begin to play with the roles of who learns and who imparts wisdom in a post-postmodern era in which the ironies of truths, however convenient or inconvenient those truths are, cannot sustain engagement and turn it into action among spectators. For spectators to be active agents in the world of science, film production models that move beyond the producer-consumer, educator-learner binaries are needed.

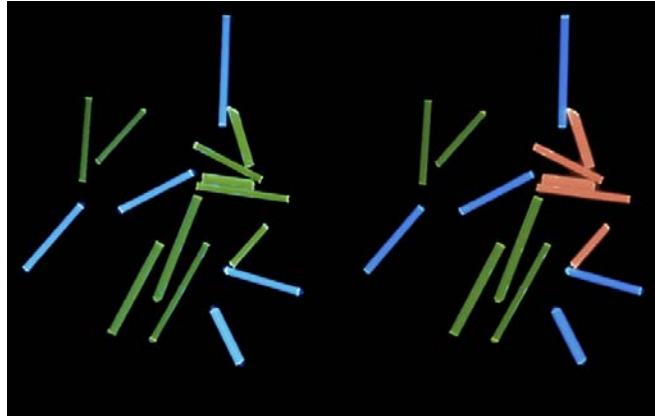
## Picturing Science

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### Fluorescing gel rods

The image on the left was taken under ultraviolet light. Unfortunately the film did not capture the orange wavelength of a few of the gels. I then scanned the film, and enhanced the image (colored some of the rods) to resemble what my eye saw. The image on the right is an example of how a “manipulated” image is more “truthful” than an unmanipulated image.



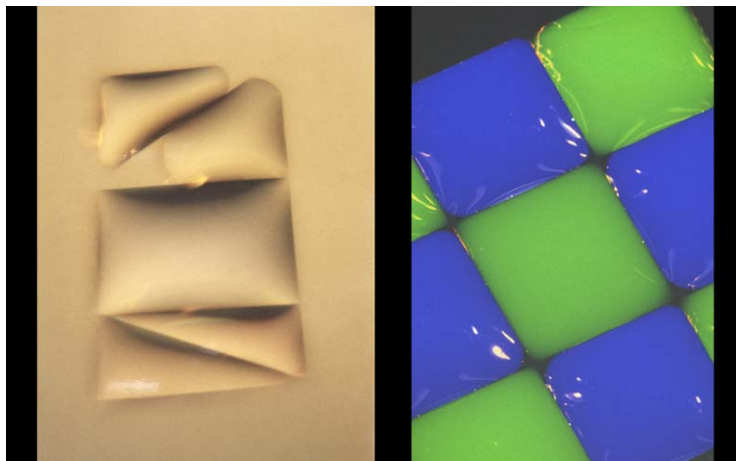
### Yeast colony

The original image of this amazing yeast colony is on the left. We see the Petri dish in which the colony grew. I wanted the viewer to see the detail of the colony and to pay attention to its morphology, so I digitally removed the Petri dish, though I always indicate when I digitally manipulate an image.



### **Proteus colonies**

For my book *On the Surface of Things*, I wanted the viewer to pay attention to the glorious patterns of the colonies and not be distracted by the cracks in the agar (on which the colonies grew). So, I digitally removed the cracks, as you see on the right. However, I always indicate to the reader when digitally change an image. It is critical for viewers to understand how much manipulation is going on when making a science image. My need to inform about my process separates me from the art world.



### **Square drops of water**

The image on the left is the scientist's attempt at capturing an image of a gold surface which was previously etched with very thin lines, making those lines hydrophobic. When water was placed on the areas without lines, the water spreads and stops at the lines. The idea was the beginning of a critical and innovative technique called soft lithography (Xia & Whitesides, 1998). My idea was to create a more interesting pattern, as shown on the right, coloring the water before placing the "drops" on the surface. The image appeared on the cover of *Science* magazine.

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## Using Telepresence to Communicate Science in Giant Screen Cinema

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*Regarding the content of giant screen cinema presentations of science, audiences are more likely to attend, pay attention, experience telepresence, develop interest and learn when the topic is intrinsically interesting and compelling, or made to appear so.*

This presentation will focus on the phenomena, theories and corresponding research evidence regarding telepresence. It will explain how and why telepresence can be an important organizing framework for the effective communication of science and important scientific controversies to the public, in particular via giant screen cinema presentations.

### Defining Telepresence

The concept of 'telepresence,' often shortened to 'presence,' emerged in an academic context beginning over a half century ago in film theory (Bazin, 1951), sociology (Goffman, 1959), telecommunications (Short, Williams and Christie, 1976), robotics and teleoperation (e.g., of equipment from a remote location) (Minsky, 1980), and communication (Steuer, 1992; Lombard & Ditton, 1997). In 1992 the first journal dedicated to the topic, *Presence: Teleoperators and Virtual Environments* (MIT Press), was founded. The International Society for Presence Research (ISPR) will host the 11<sup>th</sup> annual conference on the topic this fall.

While it is often loosely defined as the sense of 'being there' in a virtual or mediated environment and many competing definitions can be found (see Lombard & Jones, in press, for an overview), Lombard and Ditton (1997) identified six dimensions of telepresence from diverse literatures and defined the generalized concept as "the perceptual illusion of nonmediation "that occurs" when a person fails to perceive or acknowledge the existence of a [human-made] medium in his/her communication environment and responds as he/she would if the medium were not there."

During the spring of 2000 members of a growing interdisciplinary community of scholars developed a comprehensive explication of the concept through an electronic discussion on the presence-I listserv (ISPR, 2008). The lengthy explication, available on the ISPR web site (<http://ispr.info>), begins with this overview:

Presence (a shortened version of the term 'telepresence') is a psychological state or subjective perception in which even though part or all of an individual's current experience is generated by and/or filtered through human-made technology, part or all of the individual's perception fails to accurately acknowledge the role of the technology in the experience. Except in the most extreme cases, the individual can indicate correctly that s/he is

using the technology, but at \*some level\* and to \*some degree\*, her/his perceptions overlook that knowledge and objects, events, entities, and environments are perceived as if the technology was not involved in the experience. Experience is defined as a person's observation of and/or interaction with objects, entities, and/or events in her/his environment; perception, the result of perceiving, is defined as a meaningful interpretation of experience." (The Concept of Presence: Explication Statement)

Since 2006, the term telepresence has entered the public sphere thanks to the high end videoconferencing systems of Cisco and other companies, technologies said to provide the illusion of a unified physical collaborative meeting space (see Lichtman, 2006).

In short, whether the result of using virtual reality, simulation rides, home theater, video conferencing, high definition television (HDTV), home or arcade video games, the World Wide Web (WWW), 3-D IMAX films or other technologies, a telepresence experience is one in which a media consumer has the sensation of being with and connecting to people, objects and events.

Aside from its inherent interest, telepresence is important to media theory and practice because it has been linked to physiological effects including arousal andvection (a sense of self-motion) and psychological effects including enjoyment, involvement, learning (including skills training), improved task performance, desensitization, persuasion, changes in social judgments (judgments about the nature of the world) and the development of parasocial interaction and relationships with mediated characters (see ISPR, 2008 and Lombard & Ditton, 1997 for more information).

### **Evoking Telepresence**

A wide variety of characteristics of media form, media content, and media users are said to interact together to evoke telepresence in users. Media form characteristics include the number and consistency of sensory channels, image size and quality, proportion of visual field occupied by a medium's image, motion, color, dimensionality of image and sound, subjective camera techniques, interactivity, obtrusiveness of technology, live versus recorded or constructed experience, and the number of people who can simultaneously use the medium.

Content is obviously critical as well, especially the degree to which it is socially (not just perceptually) realistic, the use of media conventions which remind users of the artificial nature of the experience, and the topic and nature of the portrayal, task or activity. A key variable identified by some scholars (Green & Brock, 2000; Green, Strange, & Brock, 2002) is the use of compelling narrative or story. Media user characteristics that may be important include willingness to suspend disbelief, knowledge of and prior experience with the medium, gender, and others (see Lombard & Ditton, 1997).

## **Telepresence and Giant Screen Cinema**

While arguably every medium including the telephone and standard television and film technologies can produce telepresence experiences for media users, giant screen cinema features several of the key media form factors identified by scholars as likely to evoke such reactions: extremely large, high resolution images, in some cases with 3D dimensional cues; powerful multi-channel dimensional audio; subjective 'you-are-there' camera views; motion; color; and more. The darkened theater also serves to focus attention on the mediated experience rather than the media technology, making telepresence more likely.

The industry rarely if ever uses the term telepresence of course, but its marketing materials make clear that it recognizes the potential of these characteristics to evoke telepresence. For example, IMAX describes the "IMAX Experience" this way: "IMAX is the ultimate movie experience. With crystal clear images and wraparound digital surround sound, IMAX lets you feel like you're really there." (IMAX, 2008). The marketing often describes actual activities that the movie-goer will 'do' such as "Climb the daunting heights of Everest. Experience the weightlessness of space. Dive into the undersea world to see incredible creatures. Get behind the wheel of a racing car going 200mph. Travel into exciting sci/fi worlds." (IMAX, 2008). Some preliminary research (Lombard & Ditton, 2007) confirms the power of IMAX 3D presentations to evoke various types of telepresence, and other studies (Lombard, Ditton, Grabe, & Reich, 1997; Lombard, Reich, Grabe, Bracken, & Ditton, 2000) show the power of even a relatively small increase in image size (e.g., from 12 to 46 inches) to evoke an enjoyable sense of movement, excitement and physiological arousal with the subjective forward point-of-view movement camera technique.

## **Telepresence, Giant Screen Cinema and Science**

Clearly giant screen cinema is more capable than most media of evoking telepresence, which is likely a key reason for its appeal to the public. Because the goals of effective communication of science – changes in attitudes (e.g., increased interest in and positive perceptions of science topics) and changes in knowledge (i.e., learning about science topics) have also been identified as effects of telepresence experiences, it makes sense to look to telepresence theory and research for ways to enhance the effectiveness of the communication of science via giant screen cinema.

The various formal features of giant screen cinema discussed above (image size and quality, etc.) provide the potential for high levels of telepresence, but other features can enhance or limit telepresence. Presentations that incorporate 3D imagery and 3D or spatial audio are likely to increase the effect. Cinemas could also consider importing techniques used in simulator amusement rides that are often identified as elements of a 4D presentation: manipulations of the theater environment synchronized to the film such as changes in the room temperature, air jets, vibrating seats, artificial scents, etc. Less radical changes include reducing or segregating the inclusion of graphics, text (e.g., introductory credits) and other reminders of the artificiality of the mediated experience. Subjective camera techniques, e.g., through the 'eyes' of characters or even objects, can give audience members a feeling of participation in an experience rather than the

perception that they are only passive observers. The use of narrators, especially unseen, 'third person' narrators, should be avoided because it distances the viewer from the experience being portrayed.

Regarding the content of giant screen cinema presentations of science, audiences are more likely to attend, pay attention, experience telepresence, develop interest and learn when the topic is intrinsically interesting and compelling, or made to appear so. A key way to make a topic compelling is to present it as a story (the basis of human experience, cognition and memory according to Schank, 1991), one that 'transports' the audience on a journey (Bracken, 2005; Green & Brock, 2000; Green, Strange, & Brock, 2002). Research on parasocial interaction and relationships (Giles, 2002; Horton & Wohl, 1956) and social telepresence (see Biocca, Harms, & Burgoon, 2003) suggests the importance of presenting stories that involve compelling people with whom audiences are likely to connect. All of this requires realism, not just in how the environment, objects and people look and sound but in their correspondence to their real world counterparts: the events, dialogue and acting have to seem possible, plausible and 'real' to the audience. Nunez and his colleagues (Nunez, 2007; Nunez, & Blake, 2003; 2006) have also demonstrated that telepresence is enhanced by the audience having at least some previous familiarity with a topic and by bringing that familiarity to the forefront prior to a mediated presentation via what they call thematic inertia or cognitive priming – for example the use of sounds, images, and other stimuli related to the presentation topic while audience members wait for the experience itself to begin.

While form and content characteristics of giant screen cinema are primarily under the control of producers, the characteristics of the audience are in most cases not. Given the expense of producing films in specialized giant screen formats, designing experiences for narrow audiences is impractical. But knowing more about the diverse demographics, motivations, attitudes, and knowledge levels (about both the presentation topic and the technology) of their audiences can help producers enhance telepresence and its desirable effects. Producers can select topics with which the audience will already have some general familiarity, and bring that familiarity to their focused awareness immediately before the presentation via cognitive priming as mentioned above. They may be able to avoid hindering audience members' willingness to suspend disbelief by providing minimal or no information about the technology behind the presentation (at least prior to the experience).

Perhaps most important, producers need to account for an overall orientation of their audience toward entertainment rather than education. While some giant screen cinema audience members, especially at venues in science and other museums, may attend primarily to learn, most likely come to be entertained. A pioneer in the field of communication, Wilbur Schramm (1971), argued that there is an unspoken cultural contract between producers and audience members that varies with the goals of the relationship. If the goal is transmitting information, "the communicator is expected to be knowledgeable, accurate, and fair in his interpretations. The receiver is expected to pay attention. If either one fails to live up to these expectations, then the relationship results in disappointment or

indignation." If the goal is entertainment, "[a]n actor is expected to give a skilled performance; in return, the audience is expected for the time to suspend disbelief - not to apply reality tests to the drama, but to live for a while in its world of imagination, and use its ambiguities to stimulate their own imaginations." He goes on:

The entertainer is expected to have more concern with form than is the informational communicator. The way he writes or speaks or moves is itself expected to give pleasure. He is expected to be imaginative rather than utilitarian, to write richly rather than clearly, to tell a good story, to do an expert job of turning a phrase or building a scene. In other words, whereas informational communication asks for the skill of the reporter, entertainment asks for the skill of the artist. ... The receiver, on his part, is expected to be willing to identify with one or more of the characters, to put himself in their places, to feel with them (ibid).

If producers seek to transmit information while audience members seek to be entertained, the contract likely will be broken and either one or both goals will be unfulfilled. But if producers use the audience's goal of entertainment to evoke telepresence with a vivid and impactful experience that along the way provides the information necessary to affect their attitudes about and knowledge of a science topic, both parties' goals may be accomplished. This is the basis for theoretical and applied work in what has been labeled "entertainment-education" (Singhal, Cody, Rogers, & Sabido, 2003; Singhal & Rogers, 1999):

This approach to communication is the process of designing and implementing a media message to both entertain and educate to increase audience members' knowledge about an educational issue, create favorable attitudes, and change overt behavior. It uses the universal appeal of entertainment to show individuals how they can live safer, healthier, and happier lives. Entertainment formats such as soap operas, rock music, feature films, talk shows, cartoons, comics, and theater are utilized in various countries to promote messages about educational issues. (Singhal, Cody, Rogers, & Sabido, 2003)

If producers can generate enjoyable telepresence experiences that take advantage of the audience members' expectations based on Schramm's entertainment contract, and incorporate the key elements of information about a science topic at the same time, they can more effectively educate them as well.

## **Summary**

Theory and research on telepresence, the psychological state or perception in which a media consumer has the sensation of being with and connecting to people, objects and events, provides a potentially valuable framework for increasing the effectiveness of giant screen cinema presentations of science. By taking advantage of, and making small adjustments to, the immersive form of these presentations and by creating compelling, story-based content that encourages audience members to identify and engage with believable characters, producers can create

experiences that satisfy the audience's primary goal of entertainment while increasing their interest and knowledge regarding important scientific topics.

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## The 12 Step Program (for Communicating Science): Mind the gap!

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*Journalism urges skepticism, questioning facts and conclusions. That kind of skepticism helps people become lifelong learners, which is a goal of science communication in any format.*

We tell stories about science in many different ways. Some communicate about science visually, some communicate about science through the written word. The medium aside, the audience is still the audience, and they bring to both the written text and the film the same set of preconceived notions, education, and culture that can impact the ability of the medium to effectively explain, excite, and enthuse them about a field of study with which they likely have little direct interaction.

I come to the question of how to communicate science from a journalist's point of view. Science journalism is different from science writing and communication, and that isn't always obvious to everyone. Journalism isn't about teaching science, or about encouraging science literacy *per se*. It's about breaking news and, to quote the old saw, afflicting the comfortable and comforting the afflicted. But the two disciplines have a number of things in common, one of which is that they both seek to encourage an audience to think about science. Journalism urges skepticism, questioning facts and conclusions. That kind of skepticism helps people become lifelong learners, which is a goal of science communication in any format. Below are twelve rules I live by, sometimes consciously and sometimes unconsciously, when I write for any audience.

Rule 1. Why dumbing down isn't  
What do you know about how your car works?

Rule 2. Working with scientists  
Tell me what you'd tell a smart 14-year-old

Rule 3. Know your audience  
Just because someone has a PhD doesn't mean she knows the same things  
another PhD does

Rule 4. Numbers and acronyms  
Why is this here?

Rule 5. Resist the jargonization of science  
Language counts

Rule 6. People read (or watch) up, to a point  
What happens when you create a magazine for postdocs

Rule 7. Why is this important? What does it mean to me?  
Avoid the inside baseball/beltway problem

Rule 8. Stuck?  
Make it about people

Rule 9. Use analogies and metaphors  
You know, like a "brave new world" of science

Rule 10. Choose your battles  
When in doubt, leave it out

Rule 11. Read (watch?) it out loud  
If you read it and see it, so will they

Rule 12. Remember the Web!  
A word about the web and that awful acronym, SEO

## **An Urgent Challenge**

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*Our fragile new world demands that we retool our mission and goals, our operations and our business models to play a far more meaningful role within our communities.*

*Through deliberate planning, the cultural and social structures within our communities can become learning networks that serve a lifetime of learning.*

### **Introduction**

I once asked an audience to quickly list five words they would use to describe the state of the world today. The results, though amazingly diverse, included many versions of a core sense of anxiety, words like “fragile”, “fragmented”, “confusing”, and even “frightening.” Others words, like “global” and “information-driven”, “exciting,” and “advancing” suggested new opportunities and looming challenges. Although both positive and negative concerns emerged, by far the dominant theme was one of rapid change and its accompanying uncertainty.

I could not help but contrast the audience responses with the tone of a white paper I had authored in for the Institute of Museum and Library Services (Sheppard, 2000). The paper was a call to action to museums, libraries and other non-formal learning institutions to join together to form a broad learning network in service of a knowledge age. The tone had a rush of energy and optimism:

*Never before have museums, libraries, and the whole of the non-formal sector of educational institutions faced such challenges and opportunities!*  
(ibid, p.2)

*The learning age requires a daring new vision!* (ibid, p.5)

The paper was written, however, before 9-11, the collapse of Enron, the wars in Iraq and Afghanistan, before soaring oil prices, Hurricane Katrina, and growing recognition of our environmental crisis. It was written before the news was filled daily with talk of hybrids and ethanol, the world food crisis, the continuing devastation of AIDS, fears of pandemic, and the sinking of the American dollar. It preceded the growing promise of nanotechnology and new genetic therapies, the advent of the WII, the I-pod, and mandated digital television. It was, in short, a world beyond imagination in 1999 – in many ways -- another world altogether.

### **Collaboration: The critical need**

Today, I am profoundly aware that the optimism of my earlier words has been replaced by a growing sense of urgency. Though I feel no less driven to consider the power of collaboration among our cultural, civic and educational institutions, I no longer think of it as an option. What once felt exciting in its potential now feels wholly essential and critical. Our fragile new world demands that we retool our mission and goals, our operations and our business models to play a far more meaningful role within our communities. More than ever, I believe that the greatest potential of our related fields lies in our ability to build community-wide learning networks. For the giant screen cinemas, the promise of the future may well be in the partnerships that support lifelong learning, combining your unique kind of immersive learning with dynamic exhibitions, programs and additional technologies in the service of our communities and our audiences,

The challenges you are facing is a familiar one to museums, libraries, and a myriad of other learning places. Our once-comfortable silos, built on industrial-age business models, are under siege. They are no longer as financially stable and resilient as at an earlier time, and they are feeling increasingly out of step with a changing world. Yet, to ask any of our beloved institutions to change how they approach their core operations is a daunting request. For years we have responded with an array of short-term solutions – from adding new business enterprises like shops and cafes to engaging the latest blockbuster. What we have resisted is fundamental and perhaps revolutionary change. No less, however, may be required if we are to be meaningful, relevant and vital in a new age.

As Douglas Worts (2006, p.42) wrote in the *Journal of Museum Education*:

The world has changed fundamentally in the past century as a result of technological advances, globalization, urbanization, pluralization and exponential population growth. Human adaptation to our changing external reality and the internal integration of those adaptations, lies at the heart of our present cultural challenge. It seems clearer than ever that museums [one might substitute any lifelong learning resource, including giant screen cinema] have the potential to play a vital role in this process, but only if there is the will and capacity to examine the core assumptions regarding what museums do and how they measure their impact in cultural terms.

The capacity of free-choice learning institutions to initiate and sustain change may well be found in our ability to align ourselves as collaborators in meeting urgent social needs. One of the most critical of these is the public need to understand current issues in health, the environment, energy use, and technological change – the topics at the heart of connecting society with science to serve the greater good. Individually, our institutions produce fine films, exhibits, publications and programs toward this goal. Collectively, we can multiply our effectiveness many times over.

### **Science, trust and the public**

Undertake a Google search to explore the “public understanding of science,” and the search engine will respond with hundreds, if not thousands, of responses. In

many ways, the phrase – public understanding of science – has become something of a catch phrase, a way to distinguish between advances in science and technology on one hand, and a deficit in public embrace or awareness on the other. And yet, there are not only more curriculum-based sources of science education than at any time in the past, but there are also more day-to-day sources of popular science education programs on television, in health columns in newspapers and magazines, and even kits for growing crystals or establishing ant farms at home. Many of these efforts, however, are singular and fragmented, lacking the kind of coordinated approach that goes hand-in-hand with good teaching.

Sharon MacDonald (2002) wrote in her essay *Exhibitions and the public understanding of science paradox*, that despite the increasing number of museums and exhibitions of science, technology and medicine, accompanied with a strong public interest, the concern about public illiteracy about science-related subjects has grown. She notes that calls for action have come from scientific lobbies as well as from government entities,

All argue that science, technology and medicine are crucial to our lives and wellbeing, and that we need to be properly informed about them in order to make the right decisions in relation to our own live, both individually.... and collectively (ibid).

All cite that such information is increasingly complex, and answers are provided from many suspect sources, alongside those that many would consider more trustworthy.

In an age of “alternative” sources of information about health, science, the environment and many other science-related subjects, the need for trustworthy information that can be easily delivered to public audiences is critical. In numerous studies, museums are seen to be such trustworthy sources, lauded for their even-handedness in presenting both current science and history. They make ideal candidates for partnerships with giant screen cinemas, and indeed, many science centers and natural history museums, share facilities. Yet, the two often fail to build their stories together, to take on common goals to enrich the public’s understanding of science-based topics. Despite an impressive history of operating in tandem, drawing from the same audience, such partnership might exponentially enhance their educational power if they can become more united in their purposes and their products.

### **Repositioning museums**

The museum community continues to experience calls for radical change. Its strongest step in recent years has been the deeper embrace of its educational role. *Excellence and Equity: Education and the Public Dimensions of Museums* (American Association of Museums, 1992) urged museums of all types to place education at the center of their work, stating that education is the business of the entire museum. It is surprising to many, looking back, that such a call to action caused widespread controversy.

The document put forth an educational mandate defining an essential museum goal as

to nurture an enlightened, humane citizenry that appreciates the value of knowing about its past, is resourcefully and sensitively engaged in the present, and is determined to shape a future in which many experiences and many points of view are given voice (ibid).

What seemed new to many was the clear re-positioning of the museum in the center of society and the insistence on serving the greater good.

Yet, change has taken time. Ten years after the AAM publication, Stephen Weil (2002) argued more bluntly that museums need to be judged for their “usefulness.” He defined a growing need for museums to apply their knowledge, work and service to making a difference in solving real world issues. Similarly, other museum professionals are adapting the language of Mark Moore whose publication *Creating Public Value* (Moore, 1995) initially addressed issues in managing government agencies. Increasingly his analysis of the need for public authorization of agency activities is being applied to many not-for-profit learning institutions. There are strong voices urging museums and others, such as libraries, public broadcasting and the giant film industry, to place public value at their core and thus directly address the needs of our learning society. Collectively these institutions are exploring ways to combine their educational goals with more visible moral functions.

### **Museums, giant screen and mutuality**

Thinking deliberately about the mutual goals that museums may share with the giant screen industry, among others, suggests potential strengths. The debates over the public understanding of science, and the posturing that suggests science-based decisions should be left solely to the experts, casts the issue in a deficit position, one that can be demeaning to and disdainful of the general public. Building exciting new science explorations that use the combined powers of museum and giant screen offer the public a far more positive experience, one that seeks to invite rather than convert. Working together, the two formats can become a single, dramatic and reinforcing experience – one with the power to entertain, provoke, connect, and invite deeper inquiry. Carefully structuring ideas in tandem can develop deeper and more positive public appreciation for science, the scientific process, and the impacts of scientific accomplishments. The first vital step in supporting the public understanding of science is the creation of a positive affective environment for learning. The giant screen/museum collaborative has such potential – offering seen and unseen worlds, using the power of the authentic object (in the museum) with the drama of immersion (in the theater).

By bringing multiple formats to the learning experience, such a partnership also builds on long-accepted learning theories. It supports the impact of the physical context for learning, the ability of all ages to learn in social groups, and the need for reinforcing new ideas through repetition. Whether in a formal learning environment, such as a classroom, or an informal learning setting, such as a

museum or full-dome theater, making connections is a critical part of expanding both knowledge and interest.

As stated in a study by the National Research Council (Bransford, Brown & Cocking, 2002),

Knowledge that is taught in only a single context is less likely to support flexible transfer [the ability to extend knowledge to other contexts] than knowledge taught in multiple contexts. With multiple contexts students are more likely to extract the relevant features of the concepts and develop a more flexible representation of knowledge.

Different environments and modes of interpretation support multiple learning styles, appeal to many different ages, and encourage deeper questions. Through deliberate planning, the cultural and social structures within our communities can become learning networks that serve a lifetime of learning. The sorts of educational experience that take place in giant screen cinemas and museum exhibitions – and elsewhere in the community -- are generally viewed as fun and entertaining, qualities that can be social in nature and can support intergenerational groups, having fun side-by-side. They have the capacity to both attract and retain interest, and with thoughtful planning, they can extend the experience well beyond the theater or museum.

Consider, for example, a project undertaken by the Institute for Learning Innovation (then called Science Learning, Inc.) that added to a collaboration between the National Museum of Natural History and a 3D IMAX experience exploring the Galapagos Islands. The Institute staff, working with curators, producers and an advisory panel of scientists, developed an interactive family guide designed to deepen and extend the onsite learning experience. The project fully respected the desire for families to learn together and have the tools for ongoing conversation and discovery – reinforcing their sense of power and efficacy as a learning unit. It also provided many different types of activities, respecting a variety of interests and making as many connections as possible.

The exploration of learning partnerships can cast a wide net. Our communities are filled with informal learning institutions, from libraries to boys and girls clubs. The use of technology to reinforce learning experiences is still in its infancy. Imagine introducing a vital scientific concept through the drama of the large screen and then continuing a conversation through websites, blogs and wikis and the burgeoning technology-aided possibilities for deeper questioning and more prolonged study. Imagine further using the giant screen experience to kick off a “Café Scientifique” – building on the kind of informal conversation that has attracted wide audiences from the general public to discuss and explore even the most complex of science-based concepts. Think of the ways in which images from a film production could be met again in the midst of an exhibition, this time inviting visitor comments or questions through a “talk back” mechanism. Or, including scenes from an exhibition within the film, using the magic of filmmaking to probe more deeply or share what cannot be experienced with the human eye.

## Conclusions

Working across formats is not a simple matter. It requires a will to change and to experiment. It often feels simpler to tinker around the edges rather than to change boldly. I would argue, however, that as much as we cherish the past, our goal should not be to perpetuate it. What we have accomplished in the history of our institutions is notable, but no longer relevant. What would be richly rewarding is to use our powerful tools to build the kind of public understanding of science that is so well articulated on the web-page of the Charles Simonyi Professorship for the Public Understanding of Science (1995):

The goal is for the public to appreciate the order and beauty of the abstract and natural worlds which is there, hidden, layer-upon-layer. To share the excitement and awe that scientists feel when confronting the greatest of riddles. To have empathy for the scientists who are humbled by the grandeur of it all.

Such a noble goal requires the imagination, skills and talents, commitment and dedication of all who are so well poised, as is the giant screen industry, to make a significant difference. It demands respect for a public that deserves to be active in the ethical, political, social and financial debates that are fueled by science-based dilemmas and discussions. It sets forth a philosophy that learning is the rightful province of all – novice and expert alike – and it places wonder at the heart of the human imagination and quest to learn.

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## Student Scholarship Awardees Essays

To extend the reach of the symposium, the Montana State University Masters in Fine Arts program in Science and Natural History Filmmaking and the American University Center for Environmental Filmmaking were invited to select three students for scholarship awards to attend the Symposium. The students selected by the departments were asked to respond in writing to the following question,

*This symposium is examining the greater potential for giant screen films in the communication of science to the public. The public is defined in this case as anyone who views a giant screen film, acknowledging the fact that each audience member may have a different motivation for choosing to watch the film. The audience for giant screen films ranges from 8 to 80 years old, and a typical giant screen audience can be comprised of school children on a class trip, families on a day trip to a museum or science center, seniors visiting with a tour group, and tourists from around the world. Please discuss your perspective on the need for science communication, best practices in communicating science, how to communicate science and science controversy effectively, and the role and future for the communication of science in visual formats. In your discussion, please specifically address social and environmental needs and issues for science communication in terms of what people need to know about science to function effectively in the world of today and tomorrow.*

### Communicating Science through Giant Screen Films

Andy Adkins

Montana State University

A fantastic memory from when I was a kid was going to my first IMAX movie. Our family was visiting San Francisco and my dad - who had also never seen an IMAX film - took me to see *The Dream is Alive*. I had never even heard of these gigantic theaters - we didn't have any back home in Oregon (and wouldn't get any for several years). The thrills began before the movie even started: I remember the warning about what to do if you get nauseous and thinking that I must be in for something totally wild. The film was a radically new experience that I remember to this day, and I believe that today the same Giant Screen Films still produce the same kinds of reactions in kids and adults everyday despite 20 years of changing technologies and audience expectations.

Using the unique advantages of Giant Screen Films to help educate citizens about science is extremely important because the need for effective science communication and education is enormous and ever-increasing. The role that science and technology plays in the world continues to grow as science becomes more intertwined with society, politics and culture. Furthermore, the necessity for quality communication of science is sharpened by a host of science related issues facing the planet. Widespread environmental problems, energy crises and disease

are just a few examples of issues in need of attention and accurate explanation to the public - and all have science at their core.

But effectively communicating scientific subjects in film is not easy. While the need for good science films has grown, many factors make scientific subjects as difficult as ever to incorporate into films. The complexity of many scientific subjects and the distance that average citizens feel from science can make it difficult to engage a normal audience with science content. Additionally, media conventions tailored for the needs of the media establishment have set audience expectations such that science content is often forced into structures it is not particularly well suited for.

These and other factors combine to pose a great challenge to those of us tasked with communicating scientific information to the masses (and are exacerbated for the Giant Screen Film market given the wide ranges of audience age and motivation). But all is not lost, and the power of film should not be underestimated. During a brief stint as a middle school teacher I remember being amazed at how my students could focus on a relatively drab educational film for 30 minutes when they couldn't listen to me for more than about 3 minutes. That may say more about my skill as a teacher, but I'd like to believe that it is a testament to films potential to captivate, inspire and ultimately educate. This power is especially evident in Giant Screen Films, which routinely dazzle audiences around the world - in large part because of the sheer hugeness of that medium.

But how do filmmakers leverage this power to do more than dazzle? How do filmmakers leverage it in a way that furthers science and improves the relationship between science, scientists and the public? These challenges are addressed by balancing visual spectacle and entertainment with information - a pursuit that sounds much easier than it is. This balance, I believe, is an art form that determines the success or failure of an educational science film.

Much of my own filmmaking effort has been dedicated to finding an effective formula that captivates, entertains, inspires and informs. This formula varies from sequence to sequence, and from film to film, but the right formula results in audience education. Finding the proper formula requires knowing your subject and knowing your audience in detail, but it also means knowing your own strengths as a filmmaker and the strengths of your aesthetic. This careful evaluation allows us, as filmmakers, position ourselves in just the right place and strike just the right balance to be a bridge over the divide between science and the public.

## **Science on the Silver Screen**

Eric L. Bendick

Montana State University

It is essential to realize that science literacy for the 21<sup>st</sup> century must be integrated with our modern multi-modal communications network. In the past few decades, an explosion of small new media outlets, blogs, podcasts, and other viral information sources have arrived to fulfill the needs of various niche communities in

the current-day mediascape. Nonetheless, as these forms of distribution have proliferated, they reinforce the need for overarching projects of synthesis - literally 'community-scale' outreach efforts which go beyond the domain of niche media. In a sense, these large-scale productions such as IMAX, theatrical films, museum screenings, and what I will later define as 'guerilla-style' showings have become the waypoints and anchors for the larger informal science learning community. It is a very real risk that such important giant screen 'anchor media,' without continued investment in distribution, could become an outlier in relation to the more rapid but superficial flow of instant media. It is critical that we continue to support large format science films for their ability to educate a broad, diverse collective audience and because such media translate into more informed science policy decisions on a local, regional, and national scale. Therefore, 'large-screen' science media for the general public should be seen as a keystone in the informal science learning process.

The informal science learning community has recognized the need for multi-modal educational resources for many years. The theory behind this scholarship has been aided by cognitive research that has revealed that different individuals learn in unique modes: i.e. kinesthetic, visual, acoustical, and experiential. Informal science learning, especially film production and big-screen media, has the power to teach in modes that are traditionally absent from formal science teaching and methodologies. For example, a theatrical science film such as *An Inconvenient Truth* is able to communicate to an audience via the use of imagery, sound, music, and graphical representations – all of which are not readily available in a typical formal learning environment. In this way, big-screen science media is able to extend the platform of science literacy into a segment of the public sphere that might ordinarily be illiterate about a range of science issues like global climate change, bioengineering, as well as advances in technology, communications, and engineering. Furthermore, it is vitally important that our communication strategies reach out to this population because, in a democratic society, public priorities will inform policy decisions such as regulation, prohibition, or incentives for science research. Therefore, large-format science media has an important role in shaping the future direction of a national scientific agenda.

As a real world example, *An Inconvenient Truth* is the best recent example of the power of big-screen science-based media to reach beyond the ordinary scope of niche demographics and to strike a chord with the public that has begun to ripple into public policy. Better still, *An Inconvenient Truth* demonstrates the power of the giant screen to spark debate, dialogue, and informed opinion. Whatever your political opinion on global climate change, the real success of *An Inconvenient Truth* was that it broke a somewhat difficult and technical debate out of the traditional intellectual niche and opened the topic up for debate among the public sphere as a whole. The communal experience of watching the film theatrically and the multi-modal representation of science no doubt helped inspire U.S. citizens to think about real science as part of their everyday lives - no doubt some for the first time. Terms like 'CO<sup>2</sup>', 'atmospheric science,' 'carbon footprint,' 'emissions,' 'renewable energy,' and so forth were instantly propelled to the forefront of our public water cooler discourse. Science topics don't often make such a splash, but when they do,

the inevitable dialogue that ensues has the second-tier effect of educating the public about the 'frame of the debate.' In the case of global climate change, in order to maintain any position, one must understand a complicated series of scientific terminology and methodology including scientific method, peer review, and best practices, as well as, chemistry, geology, and ecology. Therefore, for a viewer who might otherwise not be interested or informed about basic scientific processes, film can be a point of agency and education.

It is important that visual science communicators understand and represent the contextual fabric of the content that they wish to represent. Too often, scientific objectivity is represented at face value in the visual medium and is not appropriately contextualized within a historical and dialectical lens. The more controversial the subject matter, the more clearly delineated the 'process of science' and the internal debate must be represented. It is interesting to note that the proper contextual positioning of science as taking place in an active process consisting of 'laws,' 'theories,' 'hypotheses,' 'refutation,' and 'evidence' is no different when considering the conflict between Galileo and the Catholic church or the modern debate over stem cell research. The role of the producer, writer, and production team of a large-format science film is to tell the most compelling version of the 'story of science' not to speak as the objective arbiter of scientific truth itself.

One of the most persistent shortcomings among the science education and media community is the inability to adequately reach minorities and underserved populations. It is widely acknowledged that most 'giant screen' productions within the context of museums, theatres, and science centers are more likely to reach higher-educated audiences with more disposable income. In order to 'get out of the box,' science film content producers need to re-conceptualize the idea of the 'venue' for a new digital era. The highly mobile and uniquely configurable age of digital projection endows content producers with the flexibility to become 'guerilla distributors' and leverage their content offering in underserved communities from basketball courts to rooftops to city parks.

This 'guerilla distribution' has its roots with wildlife and environmental filmmakers who have been using this technique over the past decade to reach remote communities throughout the world. Filmmakers, traveling only with a simple screen and projector, have shown their work in remote villages deep in the Congo and in Central America. These filmmakers have proven that (a) underserved communities can be educated about local ecology, environment, and issues of concern (i.e. the bushmeat trade in Africa) and (b) that films, once brought out of their institutional frame, can be galvanizing agents for communities to provoke informed debate.

Certainly 'guerilla distribution' should be thought of as one solid option in a much larger and broader toolkit to maximize public viewership and impact. In truth, giant screen science media doesn't stand alone in the distribution chain and nor should it. Rather, large-format productions should be packaged along with a suite of integrated deliverables that also reach out into the daily 'instant media' hemisphere. In this sense, a large-format film is the 'carrot' and the blogs,

websites, podcasts, and ancillary media components act as 'sticks' driving the public towards the big show. The fragmented media landscape of contemporary society demands that science films, in order to maximize reach, must think of uniting all the moving media components as part of a 'campaign-style' launch platform. In turn, the informal science community as a whole should conceptualize itself as a group of partners all of whom share a common goal: to inform, to entertain, and to prepare the next generation of citizens for the challenges of an increasingly technological and science-mediated world.

## **To Better Understand**

Heather Danskin

American University

Science has been a passion of mine since I was a child. From hiking the hills behind my house with friends, to exploring the tide pools at the local marine reserve, I have carried that sense of discovery in everything around me throughout my life. And what is science but the urge to discover, to understand? Documentary filmmaking is also a process of exploration. We take a topic and delve into it, uncovering the truth as we go, crafting a story, putting the pieces together into an entertaining and enlightening package. In this way documentaries and science are a beautiful marriage of art and ideas.

But science offers so much more than simple stimulation. It provides tools for navigating through this world, for making conscientious decisions. Through science we learn to gather facts, look at a problem from many angles, synthesize all we've learned and come up with a logical conclusion. It helps us to decipher truth rather than blindly accept what we are told is true without question. So many wrong-headed beliefs are propagated over generations this way. Science can lead to understanding, not only of our natural world, but of how to deal with each other. Learning about ecosystems, cells, and galaxies – how everything fits together, interacts, affects each other – is a valuable lesson on how to live responsibly in a modern society. What we do has an effect on everything around us, and this is a worthy lesson in many ways, from pollution to schoolyard bullying. Science also teaches us not to rely on preconceived but unsupported assumptions. Science is often represented as cold. It is true that emotions should not play a role in the process, though they are never excluded from the pursuit. But so many cold choices and terrible atrocities in our past and present could be avoided if approached with the clear eyes that science teaches us to strive for.

In spite of all that it has to offer, there are so many misunderstandings about what science is, and what it can and cannot tell us. We have reached such a division in this country between those who "believe" or "support" science and those that do not, that only recently has the science behind climate change research even begun to become accepted by the general public. I spoke with someone several years ago who asked if I believed in global warming. It seemed such an odd question to me, as if facts are things one can choose to believe in or not. He did not believe. He didn't think humans had the power to make such changes to the earth. But science

teaches us not to decide what is true based on what we would like to be true. Many think science imposes something on the world, telling us something contradictory to what we feel is true. But it is quite the reverse. Science lets the natural world speak for itself. If your methodology is sound, your findings will be facts. But a single study does not give you an answer; it mostly only rules out certain answers. Science is a constant search, an endless struggle, a slow ruling out of options until you are left with the most likely cause. To scientists, this is the greatest epic ever written.

This drama is writ large in films, and even larger on the giant screen. Films provide a sort of public announcement system for science. It is a large part of why I went into filmmaking in the first place after pursuing an undergraduate degree in biology. I found myself running into the same misinformation over and over again. Working in wildlife rehabilitation, I would see well-intentioned people bring in kidnapped baby birds, trying to rescue them. Some would even complain that while they were trying to rescue this poor baby, birds were dive bombing them, attacking them. Of course, these were the baby bird's parents, trying to save their own offspring. We could inform them of what they ought to do, and most likely that person's behavior would change, but there is always another person who makes the same mistake, and another and another. But films can reach a huge audience, spreading good, solid information to the greater public when they are made well. And, ideally, rather than feeling lectured at, they are entertained, absorbing this information with a spoonful of exhilarating sugar.

Science and natural history films are an incredible and effective way to convey information. To entertain is a great calling in our society, and films do it very well. But to entertain *and* educate is noble. I remember when I was in high school I encountered a film on public television and found myself unable to tear myself away from it. Scientists were studying the ears of whales to learn how they could create better fishing nets that whales would be able to hear, leading to fewer whales caught and killed. I was glued to the television screen. Thinking back, I am startled at how much information I absorbed as I sat mesmerized. The behavior and ecology of whales, the physics of sound, the anatomy of an ear, the engineering of a net that would make sounds that a whale can hear. And not once did I feel that I was suffering through a lesson of some sort.

Giant screen films hold a unique place in the film industry. Their wide appeal and popularity with children and families make them a powerful instrument in bringing science education to the public. Children are innate learners, and they naturally enjoy the wonder of the natural world, especially when it envelopes them like on the giant screen. When science is intertwined with entertainment in these films, children can be exposed to the world of science at a young age. If this seed of wonder and joy in exploring our world is planted when they are young, it will foster well-informed adults with a thirst for knowledge, and joy in discovery and exploration. They will carry this enthusiasm with them for life, into all other aspects of their lives. It means their life will never be dull if they are always looking, wondering, thinking, guessing, exploring. They will be not just interesting

but interested. I know I am endlessly grateful for the inquiring mind that I developed as a child.

The wondrous varieties of science films available to the public all have a place in educating their audiences. Those with less hard-hitting messages ease new viewers into caring for an animal, topic or issue. This may lead viewers on a path to seek out more information, to open them up to learning more. Science and conservation films are often confronted with the problem of preaching to the choir. But audiences can move from *March of the Penguins* to *An Inconvenient Truth* to activism when those paths are open to them in accessible ways. We all have different starting points, and films offer an enjoyable diversity of options.

More and better information can only lead to better decisions. But we have always had a tortured relationship with science. While glorying in the cures of medicine, it takes us a long time to come to terms with changes to our world view. Many did not want to believe that the earth moves around the sun or that we evolved from a common ancestor of the ape. With echoes of the Scopes Monkey Trial recurring today in the battle between evolution and intelligent design in public schools, it is as important as ever to bring science education to the public. So many myths and misunderstandings are prevalent about evolution, climate change, ecology. We, as voting citizens, and our representatives can make better decisions on how to tackle our most pressing problems when we have both good information and a mindset open to understanding it. But science itself does not have an agenda. It does not belong to the right or the left. It only asks the question. And those questions are what define us. When we stop asking the questions, we stop moving forward. And if there is anything that can be said of us as a species, it is that we certainly march to the drumbeat of time.

## **Interactive Potential: Giant Screen Film's Role in Science Communication**

Lauren Demko  
American University

Having been employed in the world of education for the past six years, I have had the opportunity to see firsthand how learners of all ages truly benefit from media technology. Whether it is my elementary students crammed in close to a computer to watch a graphic animation of a volcanic explosion, or my high school-aged learners using a projection screen to analyze a movie sequence shot by shot, it seems to be that it is the interactivity visual media affords its participants which makes it a most valuable tool in the learning process. As television and movie-viewing is often a social event in our culture, this interactivity is present even when it would seem that there is nothing more for the learner to do but watch. While the parents of yesteryear might protest that the television will rot your brain, in a world of shortened attention spans, if utilized productively, the “mind-sucking” screen might, in fact, be the one thing to advance our knowledge.

Since the emergence of screen entertainment, we have been conditioned to think that that which is on the screen is hegemonically valuable, and therefore we are also conditioned to pay more attention than perhaps to the same information given by a textbook or (woe unto the education system!) a dull and uninspiring teacher. The power of the visual image is undeniable, and the importance of finding a successful medium to transmit our ever waning knowledge is becoming almost desperate; in 1997, the Third International Mathematics and Science Study (IMSS), the largest international study in human achievement ever conducted, published its findings, which proved dismal for the U.S, a country once a leader in these fields. This study concluded that, "by the time students reach their senior year in high school, they rank below their counterparts in 17 other countries in math and science literacy" (Symonds, 2004).

The situation is just as grim today: the 2003 IMSS report published in 2007 found that "no measurable changes were detected in the average mathematics and science scores of U.S. fourth-graders between 1995-2003...the available data suggest that the performance of the U.S. fourth graders in mathematics and science was lower in 2003 than in 1995 relative to the 14 other countries that also participated in both studies" (Institute for Education Sciences, 2007). The need for science communication is paramount to successful leaders of the future; without scientific understanding, there can be no medical breakthroughs, technological employment will continue to be outsourced and global changes will never be understood. Science is our past, our present and our future and with America's diminishing understanding of the subject, we are very quickly losing a most important knowledge base. It is clear that we are no longer reaching our students in the conventional manner and must now find new ways to merge the understanding of science communication with content that will speak to the learners of today.

Giant screen films have perhaps the greatest potential to do just that. The format of this technology, roughly 73 feet wide by 53 feet tall brings viewers directly into the story screen. From the tiniest molecule to the biggest mountain, audiences can get up close and personal with the content. It is perhaps this that we are missing so much from learning guidelines today – "teach to the test" has become the mantra for teachers in public schools across the country. While well intentioned, the No Child Left Behind Act has stopped allowing teachers and students to delve deeper into subjects that fascinate and excite. Rather than spend extra time with that which gets our students of today passionate about learning, this new system of education tends to put the brakes on a more detailed approach to the subject matter. The interactivity of the visceral experience that a giant screen film affords can be a great compromise – a compromise between learners of any age desperate for educational communication that speaks to the mindset of today, and solid scientific fact and content that must be imparted in order for lessons to be learned.

The educational matter of the giant screen film is an invaluable source to the expanding awareness of its viewers; it has an innate ability to teach while telling a story, and while putting that story into a current context. These stories are what make people care and believe, whether fact or hypothesis, that which is presented.

3-D capabilities, now being employed by the giant screen film industry, can almost literally take audiences inside the subject – the exhilaration of science presented in this format can impart knowledge to even the most obstinate student. Just imagine yourself, a giant screen audience member being projected, as a red blood cell would, through the chambers of the heart, taking the same voyage through the atria, into the mitral valve, entering the ventricles and exiting through the aortic valve, all the while seeing the synapses and electrodes firing off around you. The process is one thing to read about in a text book, and something completely different to experience almost first hand – try to forget an experience like that! (I know I haven't, it was something I experienced a long time ago at Walt Disney World's *Body Wars* when I was a child, and it's something I have never forgotten!) Perhaps a graphically animated voyage into the human body isn't for you – imagine then, soaring over a coastal landscape, watching film that has been shot year after year, detailing the pattern of erosion of a cliff-face. While this feat is possible through even a consumer camcorder, nothing can bring the footage to life like that of a giant screen film.

These illusions of experience are what set the giant screen film apart from other interactive technologies and make them perhaps the most valuable tool in the communication of scientific education. By utilizing this power, along with the technological capabilities of the giant screen film to showcase not only things that are, but also things that could be, it seems inevitable that the giant screen film should secure itself a role in the future of science communication.

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## New Insights Equal New Realities

Charles Dye  
Montana State University

Watching my four-year old son learn about this world, I sometimes wince at his infinite selfishness. I wince because I remember that was my reality once as well, and because I know I'm still only part of the way down a path towards greater awareness and understanding. Of course my son can't be faulted for his current worldview—it's where each of us *Homo sapiens sapiens* begin, trapped in our own bony skulls and hungry bodies, briefly seeing, hearing, smelling, tasting, feeling this world and all we share it with.

Culturally, I suppose, my son deserves a break as well. He was born an American in the rural West—he's on his way to becoming a rugged individual, a self-reliant man alone who will innately know what's right and wrong, above and beyond any man-made law—or so some movies would have us believe.

Indeed these Western lands are where our mythic American contrariness is sometimes taken to absurd ends. A million miles of barbed wire fragment the habitats of those creatures whose likenesses decorate our disposable homes. We are, as a majority, disbelievers in evolution, and relatedly (but far worse), manifesters of an eminent apocalypse. This is not just because living out here is so strangely, visibly and painfully dependent on oil. It's mostly because we have never even considered that there could be any other future.

That we might not all be headed straight to hell in hand-basket is an insight I first heard in my 30s, while living in Seattle, during a speech by Chris Peters, a Yurok tribesman. It was an astonishing, life-changing recognition—that I had just been assuming that things were bad, and that the only route to better was through much, much worse.

It only took an instant for that 'reality' to crumble into an empowering awareness.

People might still manifest an apocalypse, but for the first time in my life that did not seem inevitable. It was no longer my truth, or 'natural' in any way. It was a simply limited way of seeing, of being, and therefore of creating. It was a myopic, (culturally-) selfish assumption.

In the years since then I've begun to realize that I had actually heard the heart of that message before, time and time again, in nearly every science class, film, article, or exhibit I had ever experienced. Moreover, it seemed to me that what I had heard in all those 'scientific communications' had prepared me to understand Chris Peter's message.

At its most basic, and perhaps most important level, my education in science taught me that a person can look beyond their own assumptions and question what is assumed to be truth. Through my 'science education' I came to see that I am, and we are, to some extent, persistently fallible, self-concerned, and frequently taken with erroneous idea(s).

Science is the discovery of knowledge by verifiable means, and knowledge is a general awareness, or possession of information, facts, ideas, truths, or principles. Science is about questioning; about not taking for granted what is assumed to be the case. I find it, therefore, a path of hope, especially for those many people in our society currently trapped in the dominant apocalyptic paradigm of our times.

William Cronon wrote in the Forward of *Uncommon Ground, Rethinking the Human Place in Nature* (1996), that, "At a minimum, we need to enter into a dialogue with people about why they think as they do." I couldn't agree more. This seems to me like it ought to be a primary responsibility of anyone involved with delivering a film to a general audience—especially a science film to a general audience in this myth-constrained, often anti-intellectual nation.

Why do we think as we do? This question cannot be overly put-forward in our society.

With this in mind, I'll mention that I've seen a shift in the tone of the films I now create, and even in the tone of the films I encourage my students to make. It is not acceptable now for us to merely point out what is wrong in this world, in some romantically doomed, or importantly strident way. My films, and those of my students, are now somehow not hopeless. They may not be offering any easy solutions to whatever issue they are exploring but neither are they wallowing in fruitless self-absorption.

Again, William Cronon (1996), in the previously mentioned forward, wrote in regards to "the crucial task of self-criticism" that an "aversion to criticism is understandable, but ultimately disastrous." Likewise, it is my sincere opinion that we can't avoid making films or screening films that question ourselves, that question our motivations, and that in so doing celebrate and verify our quest for awareness and information.

To quote Cronon (1996) from the same text, one last time, "There are very real constraints on our ideas and actions, and if we fail to take these into account, we are doomed to frustration if not outright failure. The material nature we inhabit and the ideal nature we carry in our minds exist always in complex relationship with each other, and we will misunderstand both ourselves and the world if we fail to explore that relationship in all its rich and contradictory complexity."

Science film can, and in my opinion, must be one of the primary public sites of this necessary exploration. The world is both ideal and material. How we think is what we do, which has very real material consequences. "The material nature we inhabit" has long been science's workspace—to the great benefit of many of us on this planet—but when I think about my community here in the American West, I sense that a deeper understanding of this world is still very necessary. For science film—the communication of greater awareness—to avoid any discussion of the 'ideal' that 'we carry in our minds' is to knowingly to leave too many people unconsciously hopeless, dimly living in dread of the collapse that this world 'must' soon experience.

As an industry it seems to me that giant screen film could have no higher purpose than communicating science in a way that is cultural considerate. That's obviously engaging in a process rather than setting any clearly attainable goal, and to some extent it's already what any film, and even science in a general sense already does.

I do think a subtle shift has to occur however, in our 'communications' of science. It starts with that insight that Chris Peters offered me—that nothing is preordained; that we are all responsible for our actions and all interrelated; that there is hope and great need for good work still to be done. It involves honestly and respectfully striving to recognize how each of us, individually and collectively, see and engage with this world culturally.

My son's selfishness is perfect for where he is now in his life. It makes sense. As a species—as just a part of an infinitely complex, interrelated whole—it's right that we now shed as much of our collective selfishness as we can; that we start to

understand that our 'reality' is something we ourselves have a hand in constructing, a situation which therefore leaves us with an ethical responsibility to make it as right as we can.

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## Its all about the Experience

Katie Kassof

American University

The act of experiencing a giant screen film is the industry's most valuable asset. The larger than life screen, in your face images, 3D surround sound audio, and even 3D pictures combine in a way which no other media outlet does. In recent years, Hollywood has realized the economic potential of these features by releasing movies like *Harry Potter and the Prisoner of Azkaban* or *Star Wars: Episode II* for giant screen. The documentary world must embrace these unique characteristics and take advantage of them in their films, not only for economic gain but for the educational potential too. And perhaps the most easily influenced audience is children.

Though a truly well-made documentary will be educational in itself, the best way to communicate ideas and have them stick is to take a multifaceted approach. By supporting school programs and creating curriculum to accompany a film, filmmakers can reach their audiences in several different ways. Entire educational programs can be created with the help of science museums and school systems which bring kids to the theater to see a film and then reinforce the material through interactive lessons in school. The internet also has huge potential for creating interactive educational games to compliment films. By letting children become completely engrossed in a topic, not just for a 40-minute film but for an entire week, there is much more of a chance that they will learn from it as well as continue to foster an interest in the subject.

For the rest of the population science education is equally important. Science provides a basis of understanding in a world of ever increasing technology, medicine, and environmental concerns. Educating the general population about basic scientific principles is extremely important in order for them to better understand their world, especially with regard to the environment. This is true now, more than ever, because of how political environmental issues have become. People should have every opportunity to understand the changes happening to our earth, and the role humans play in these changes, in order to choose the best course forward with confidence. Science also allows people to take ownership of their world and their lives. The more people understand the earth's systems and where humans fit into them, the more responsible they become for their actions. Understanding and responsibility are what will cause people to change their habits and create a new way of life.

Unfortunately, many people are scared of science. They remember struggling through their 11<sup>th</sup> grade chemistry class (or similar experience), an event which has ruined most people's thirst for science knowledge. With cable TV and the ever expanding array of channels, it is becoming more popular to enjoy traditional documentary channels, such as the *Discovery Channel* or *National Geographic Television*. However, these networks' increase in viewership seems to be inversely proportional to the educational value of the documentaries they show—meaning that even though more people are watching the traditional documentary channels, they are not necessarily watching more documentaries. In many cases they are watching reality shows, game shows, or make over shows. That is not to say that some level of education might be gained by watching these programs, but there seems to be very little hard science actually communicated.

Big screen cinema can offer a solution to our “documentary” saturated, science deprived society. By using its powers of awe and attraction, giant screen cinema entices people to flock to amazing displays of the world they have no other way of experiencing. Within these entertaining displays, the captive audience can be educated as well as amused. There is little other opportunity in the documentary world to capture an audience, giving them no option to change the channel or get up and leave. The giant screen characteristics present an experience which not only can disguise education as fun but also communicates in a purely unique way. Whether an audience member comes because of the huge screen, is interested in the topic of the film, or is looking for an air conditioned escape from a hot summer day, there is a common opportunity for the giant screen film to do a social good in the world beyond entertainment: it can and must educate.

American audiences want to be entertained, especially when the cost of a movie ticket can be upwards of \$15. Simply put: audiences want their money's worth and education does not seem to be a viable commodity, at least not in the movie industry. Therefore it is important to maintain some element of entertainment, even in hard science documentaries. Perhaps this is easiest to achieve with natural history films. Seeing larger than life lions or tigers prowl a five story screen is certainly entertaining enough (Hollywood can hardly recreate the drama and suspense a large cat on the chase can offer). Great images are the catalyst for a great giant screen film; even the name “giant screen” indicates their importance to the medium. But more than beautiful images are necessary to capture and hold on to an audience viewing an educational film. And because audiences today are continually wooed by the media, with everything from explosive Coca-Cola advertisements to violence on the 6 o'clock news, our job as documentary filmmakers is even more difficult. Our competition is big money; big colors; big actors; Hollywood. We must be creative in finding ways to attract audiences and even more creative in how we are going to ensure they leave having learned something.

The one basic thing Hollywood has which many documentaries have overlooked are character based stories. People like to tell and be told stories; it is an integral part of our society. Science does not easily lend itself to storytelling, at least not with a head on approach. However, telling the story of the scientist in pursuit of the

newest subatomic particle could be interesting, especially if this person happens to be a real character themselves: unique, quirky and personable. Telling a story of the person behind something scientific is an extremely effective way of both giving an audience the story they crave while mixing in the science we want them to absorb.

Animal narratives are always popular and usually successful as well. Taking the audience on a journey of mother and baby by way of an elaborate narrative of their lives, hardships, deaths, etc, is usually an equation for success. The problem with the animal narrative (proven time and again to be successful with films like *March of the Penguins* and *Whales*) is that it is often manufactured, scripted for suspense and joy in all the right places. It is not necessarily real and, therefore, might not be "documentary". This ethical dilemma has been debated over and over again to come to no strict conclusion. Many believe that as long as the audience leaves learning something, then the fabrication is acceptable: the ends justify the means. However, as people put more and more trust into the media, especially into the documentaries they see, it is imperative to present factual information. What happens to the person who learns that the baby whale they were watching become an adult actually died during production so the filmmakers found another one to complete the story? Or that the wolf cub they've become so attached was filmed in a zoo somewhere in the Midwest, not in the wilds of Alaska? They will feel betrayed and their perception of the documentary world will forever be skewed. Once lied to by a so-called documentary film, the credibility of the film industry can be lost all together. This is just an example of why stretching the truth for entertainment's sake should be avoided: in addition to the ethical dilemma it presents (offering falsities as truth), it can be economically damaging to the industry. And filmmaking, after all, is a business—the bottom line overruling nearly everything else.

The irony of the situation is that science strives to find truth in the world but often science documentaries falsify the truth for economic gain. This cycle has been happening for so long that it is now not only accepted but, in some cases, it is necessary to attract audiences. Our society of big action, big stories, big Hollywood, has simply created a machine to mislead the mass population. It is up to current and future filmmakers to slowly swing the pendulum back towards the side of truth by creating new ways to draw audiences in. Story is key but ingenuity and creativity can reveal true stories which are both fascinating and real. In the long run, factual science documentaries will benefit our society by providing a way for general audiences to better understand the world in which they live. Educated people become responsible members of society, thinking twice before buying three bottles of water a day or illegally traded rare animal skins from China. Everyone deserves the right to learn and giant screen documentaries can be the mechanism to provide mass education to America's audiences.

## About the film programs

**American University**, Washington, DC, USA  
Center for Environmental Filmmaking  
<http://environmentalfilm.org/>

The Center for Environmental Filmmaking, created five years ago by Professor Chris Palmer, was founded on the belief that environmental and wildlife films are essential educational and political tools in the struggle to protect the environment. The Center's mission is to train filmmakers to produce films and new media that inspire conservation, are highly entertaining, ethically sound and educationally powerful

The Center creates partnerships with well-established organizations that give students the opportunity to produce professional films; brings world-class filmmakers to the AU campus to teach and mentor students; provides innovative, enriching programs and classes; and advocates for the ethical treatment of wildlife and the environment worldwide.

What unites the Center's many programs-besides a commitment to conservation-is the desire to transform students' lives. We show students that through hard work, perseverance, and creativity, they can bring focus, passion, and meaning to their films and their lives. We value the exuberance that comes from being creative, the courage to stand up for what you believe in, and the compassion to care for those who can't speak for themselves. These are fundamentally important values that will benefit students throughout their lives.

**Montana State University**, Bozeman, MT, USA  
MFA in Science and Natural History Filmmaking  
<http://naturefilm.montana.edu/index.php>

The graduate program in Science and Natural History Filmmaking at Montana State University is the first program of its type in the world and remains the largest and the most well-known. Their mission is to provide new generations of filmmakers who have the knowledge to create accurate and interesting programs that advance the public understanding of science. Students in the program have had their work broadcast in many major venues such as The Discovery Channel, National Geographic, The Science Channel, CNN, Sixty Minutes II, Larry King, CBS Evening News, and NBC Nightly News. They have produced films for the National Park Service, the National Science Foundation, the Department of Agriculture, NOAA, NASA, the Wildlife Conservation Society, the Sierra Club, the Audubon Society, and the Nature Conservancy.

Students in the program come from a wide variety of backgrounds including the physical sciences, the social sciences, engineering, technology, medicine, and law. Virtually no two students have the same educational background, which makes for a thriving and organic interdisciplinary environment.

## Appendix 1. Photographs



*Alice Apley*



*Randy Atkins*



*Ann Marie Barry*



*Fiona Cameron*



*Lisa Cartwright*



*Felice Frankel*



*Valentine Kass*



*James Hyder*



*Valerie Knight-Williams*



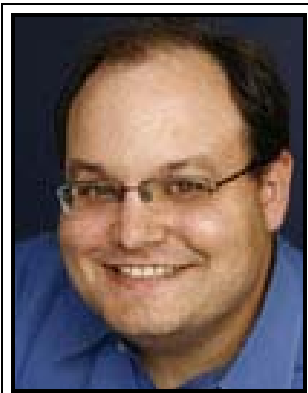
*Emlyn Koster*



*Matthew Lombard*



*Mary Nucci*



*Ivan Oransky*



*Beverly Sheppard*



*Jeffrey Sturchio*

## **Appendix 2. Biographies of Filmmakers and Speakers** (alphabetical order)

### **Alice Apley**

Alice Apley, Ph.D. is a cultural anthropologist, who applies her qualitative research methodologies in the evaluation of informal education projects. As a Research Associate at RMC Research Corporation, she conducts front-end, formative, and summative evaluations for museum and media clients. Prior to working as an evaluator, Alice spent over ten years working at the intersection of media and education, teaching video production, writing grants for educational film and television, and conducting library and archival research for museum exhibits.

Alice's current research interests include the educational potential of film and other media, and the use of audience-based research to deepen our understanding of how different media communicate. She recently returned co-directed and co-edited *Remembering John Marshall*, a 16-minute documentary film about the anthropologist and filmmaker. Alice has taught university courses in Documentary Film and Visual Anthropology, and served as a panelist for the National Science Foundation and the National Endowment for the Humanities.

Alice holds a Ph.D. in Cultural Anthropology and Certificate in Culture and Media from New York University, and a B.A. from Wesleyan University where she majored in the Science in Society Program. After college, she spent three years as a Peace Corps Volunteer teaching agricultural science to middle school students in Botswana, southern Africa, where she also conducted her doctoral research.

### **Randy Atkins**

Randy Atkins is the senior media/public relations officer for the U.S. National Academy of Engineering (NAE), where he assists journalists with coverage of stories about engineers and engineering. He does weekly reports called "Innovative Engineering" on the Washington, D.C. region's most listened-to radio station, WTOP (FM/AM), an all-news format CBS affiliate, and on Federal News Radio, WFED (AM). He is leading a high-profile effort, involving a blue-ribbon committee of leading technological thinkers chaired by former U.S. Secretary of Defense William J. Perry, to identify the 21st Century's "Grand Challenges for Engineering." Randy was involved in the conception and design of a nationwide workshop series called "News & Terrorism: Communicating in a Crisis" and is the project leader, working in collaboration with the U.S. Department of Homeland Security and the Radio-Television News Directors Foundation.

Before joining the NAE, Randy worked as senior science writer at the American Chemical Society and senior media relations coordinator for the American Physical Society. Previously, he was a producer and reporter of the nationally-distributed Inside Science TV News and an on-air television reporter for NBC network affiliate WVVA-TV. Early in his career, Randy worked as a microbiologist in laboratories at the National Institutes of Health and the U.S. Department of Agriculture. He attended Bucknell University and the University of Florida and holds a degree in microbiology.

## **Ann Marie Barry**

Ann Marie Barry [B.S., Ed.; M.A. (English-American Literature, Salem State College; M.S. (Mass Communication-Advertising), Ph.D. (Perceptual Psychology, Literature and Film) Boston University] is an interdisciplinary scholar whose chief interest lies in the neurological dynamics of visual perception, visual aesthetics and the personal and cultural influence of film.

Dr. Barry joined the Boston College Communication faculty in 1984, where she regularly teaches courses in Visual Communication theory and aesthetics, Visual Design, and interdisciplinary critical analysis. Professionally, she serves on the Board of Editors of the Visual Communication Quarterly Journal and the Board of Directors of the International Visual Literacy Association (IVLA). She is a past chair of the Visual Communication Division of the International Communication Association and Vice President of the IVLA.

Recipient of several research awards in Visual Communication from national and international organizations, including the lifetime research achievement award of the International Visual Literacy Association (2002) and the Outstanding Visual Communication Research Award from the National Communication Association (2007 and 2001), Barry has also been cited in the Harvard Graduate School of Education Honor Roll of Educators (2005), and authored several books, including *Visual Intelligence* (SUNY, 1997), and numerous articles related to the neurological underpinnings of visual perception and aesthetics.

Her interest in how the brain appreciates the visual world and makes sense of what it sees has taken her on an interdisciplinary journey that has included the study of literature, comparative religions, cognitive psychology and visual neurology. She is currently completing a book uniting visual process, cognition, emotional reasoning, and media influence, tentatively titled *How Images Mean*. Her focus on science as a foundation for visual theory promises a firmer foundation both for visual communication research and for the understanding of science in and through media.

## **George Butler**

George Butler is an award-winning filmmaker and photographer, and president of White Mountain Films (WMF). He has produced and directed the classic films *Pumping Iron* (1977) and *Pumping Iron II: The Women* (1985), both of which enjoyed critical acclaim and commercial success. In 1990 Mr. Butler produced and directed *In the Blood*, a controversial film about big game hunting and animal conservation, set in Kenya, Tanzania and Botswana. The film appeared at the Sundance, Toronto and Leningrad film festivals, and was selected as a finalist for the 1990 International Documentary Award. Recently, Mr. Butler produced and directed three films based on the best-selling book, *The Endurance: Shackleton's Legendary Antarctic Expedition* by Caroline Alexander. *The Endurance*, a theatrical documentary, won awards at over 30 major film festivals and the National Board of Review award for Best Documentary of 2001. The television version of the film was nominated for two British Academy awards and won two Emmys, while the IMAX® version won the Giant Screen Theatre Association award for best IMAX® of 2001.

*Going Upriver: The Long War of John Kerry*, the story of John Kerry and the war in Vietnam, was premiered at the Toronto Film Festival in 2004, and earned high praise across the country and is a selection for the 2006 Whitney Biennial. Mr. Butler's latest film, *Roving Mars*, an IMAX® produced by Frank Marshall and Kathleen Kennedy, is now being distributed by Disney around the world, and was named by The New York Times "the best IMAX ever made." Current and future film projects on Butler's list are: *The Lord God Bird* (a film made in association with the Cornell Lab of Ornithology and the Nature Conservancy), *Gorilla* (an IMAX® in association with the World Wildlife Fund), *The Good Fight* (the Bobby Bowden story), and *Burning Bright* (an IMAX® about Bengal Tigers).

### **Fiona Cameron**

Dr. Fiona Cameron is the Research Fellow, Museum and Cultural Heritage Studies. Fiona is a leading scholar in the field of museum studies internationally. Her research and writing focuses on the idea of the museum and interrelationships between institutions and contemporary societies in an increasing complex and globalising world with projects in two areas of interest. The first examines the agency of the museum sector in public culture in the representation of 'hot' topics of societal significance and importance. The second investigates digital technologies and museum collections. She has been a recipient of four ARC Linkage grants, the most recent, *Global Citizenship and the agency of the museum sector in climate change interventions*. Fiona regularly conducts research with partners in the United States, Canada and the UK. Publications include five book chapters, numerous articles in refereed journals and a co-edited collection, *Theorizing Digital Cultural Heritage: a critical discourse* (MIT Press, 2007).

Fiona also has a background as a museum practitioner and has worked in the sector as a museum director, a social history curator and as a curatorial consultant on major exhibition projects in New Zealand, Australia, Singapore and Vanuatu.

### **Lisa Cartwright**

Lisa Cartwright is Professor of Communication and Science Studies and a faculty member in Critical Gender Studies at the University of California at San Diego. She is the author of *Moral Spectatorship: Technologies of Voice and Affect in Postwar Representations of the Child* (Duke 2008); *Images of Waiting Children: On the Visual Culture of Transnational Adoption* (forthcoming from Duke University Press); *Screening the Body: Tracing Medicine's Visual Culture* (Minnesota 1995), and she is coauthor, with Marita Sturken, of *Practices of Looking: An Introduction to Visual Culture* (Oxford first edition 2001, second revised and expanded edition 2008). With Constance Penley and Paula A. Treichler, she is co-editor of *The Visible Woman: Imaging Technologies, Gender and Science* (NYU 1998). Her current research projects include a book she is writing about animated film, neurology, and the body; and a visual ethnography she is just beginning about the role of wind power in the transformation of US farming communities in the 21<sup>st</sup> century.

### **George Casey**

Four time Academy Award nominee George Casey served as President of Graphic Films Corp. of Hollywood, for more than 20 years where he specialized in directing,

writing, and producing motion pictures in IMAX 70 mm and other giant screen formats. Mr. Casey's IMAX format films have been viewed by tens of millions of viewers on giant screens throughout the world. These films include *Africa: The Serengeti*, *Alaska: Spirit of the Wild*, *Forces of Nature*, *Ring of Fire*, *Amazing Journeys*, *The Great Barrier Reef*, *Genesis*, and *The Eruption of Mount St. Helens*.

In the course of these productions, Casey directed crews on location throughout the world, filming on every major continent except Antarctica. *Forces of Nature* was selected as Best Giant Screen Film for Learning by the Giant Screen Cinema Association in its annual Consortium meeting in Boston in 2005. The Academy of Motion Picture Arts & Sciences nominated *Alaska: Spirit of the Wild* for an Academy Award for Best Documentary Short Subject in 1997 as was *The Eruption of Mount St. Helens* in 1980 (the first IMAX format film so nominated).

Casey graduated with honors from the University of California-Los Angeles with a Masters degree in Journalism. He is a member of Phi Beta Kappa, Kappa Tau, Alpha, and the Academy of Motion Picture Arts & Sciences.

He now lives in San Diego, California with his wife Ellen. They are the parents of three children, all of whom have worked on his large format film crews. Their eldest son, Sean Casey, is currently at work filming and directing in America's Midwest for his eighth consecutive year on his IMAX film production, *Tornado Alley*.

### **Felice Frankel**

Felice Frankel is a Senior Research Fellow in the Faculty of Arts and Science at Harvard University where she heads the Envisioning Science program at Harvard's Initiative in Innovative Computing (IIC). Working in collaboration with scientists and engineers, Frankel's images have been published in over 300 journal articles and/or covers and various other publications for general audiences. She was named the 2007 winner of the prestigious international Lennart Nilsson Award for Scientific Photography, was profiled in the *New York Times* Science Section and the Apple website. Frankel was previously awarded a Guggenheim Fellowship, and received grants from the National Science Foundation, the National Endowment for the Arts, the Alfred P. Sloan Foundation, the Graham Foundation for the Advanced Studies in the Fine Arts and the Camille and Henry Dreyfus Foundation. She was elected as a Fellow of the American Association for the Advancement of Science and was a Loeb Fellow at Harvard University's Graduate School of Design for her previous work photographing the built landscape and architecture. Her book *Envisioning Science, The Design and Craft of the Science Image* is now out in paperback. (The MIT Press). A tenth anniversary edition of her book, co-authored Harvard chemist George M. Whitesides, *On the Surface of Things, Images of the Extraordinary in Science*, (Harvard University Press) is now in bookstores.

She is founder of the Image and Meaning conferences and workshops whose purpose is to develop new approaches to promote the public understanding of science through visual expression. She is leading a newly funded NSF undergraduate program, "Picturing to Learn" and is spearheading new efforts to create a virtual graphical community in science and engineering.

## **James Hyder**

James Hyder, founder, publisher, and editor of *LF Examiner*, has had experience in all phases of the giant-screen business -- production, distribution, and exhibition -- since joining the industry in 1984. In the 1970s, Hyder worked hands-on in audio and video production. In 1984 he started working in the Langley IMAX Theater at the Smithsonian's National Air and Space Museum. As manager of the most popular IMAX theater in the world, he learned the concerns of exhibitors. While at NASM he assisted in the development and production of several IMAX films, including *Cosmic Voyage*, (although he modestly declines to accept any direct credit for its Oscar nomination). In his last position at the Smithsonian, Hyder researched the giant-screen distribution business and developed a plan for a film distribution office for the Smithsonian.

In 1997 Hyder founded MaxImage!, the first independent publication dedicated exclusively to the giant-screen industry. He has been its editor and publisher through its renaming to *LF Examiner* in late 2000 to the present day. He holds a B.A. in the classical liberal arts from St. John's College in Annapolis.

## **Valerie Knight-Williams**

Dr. Knight-Williams, Director of Knight-Williams Research Communications, specializes in the development and evaluation of educational media and outreach projects targeting diverse audiences. The firm is based in Sacramento with associates located in San Francisco, Washington D.C., Miami, Portland, Chicago, and Seattle. Dr. Knight-Williams collaborates on projects that are frequently national or regional in scope, target public and/or professional audiences, and typically incorporate one or more of the following media: television programs, giant screen films, radio programs, museum exhibits, websites, interactive multimedia, and curricula or other print materials. She works with a wide range of clients, including production companies, museums, government agencies, school districts; institutions of higher education, community agencies, and other educational organizations.

In the giant screen industry, Dr. Knight-Williams has evaluated and consulted on several films funded by the National Science Foundation, as well as presented at previous GSCA conferences.

Prior to starting Knight-Williams, Dr. Knight-Williams served as senior evaluator at Boston University's Center for Educational Development in Health. Previously she was an instructor and exhibits and curriculum developer at the Lawrence Hall of Science. Dr. Knight-Williams received her Master's and Doctorate degrees in Human Development and Psychology from Harvard University, with a concentration in educational media. Her undergraduate degree was completed at Wellesley College and the Massachusetts Institute of Technology, with a major in Psychobiology.

## **Emlyn Koster**

Internationally experienced and dedicated to improving the links between science and society, Emlyn Koster has been President and CEO of Liberty Science Center in Liberty State Park, Jersey City since 1996, and recently spearheaded its major

expansion and total renewal. This is New Jersey's most visited museum, one of the New York metro region's top-rated cultural destinations, and a new relevancy-driven benchmark in the science museum field that has just been recognized as among the nation's top ten science centers by *Parents Magazine* with its 15+ million readers. Innovations feature inclusive approaches to audience, exhibition and program resources geared to living, learning and working in the surrounding region with a global context, extensive partnerships with preK-12 education and teacher professional development, and new applications of videoconferencing and cell phones. Following the terrorist attacks on the World Trade Center, the Center assisted in a wide variety of emergency roles that went on to shape thinking in the museum field about adaptive responsibilities when disaster strikes: the Center continues to be resource to the Families of 9/11. In sequence since reopening, its bold choice of touring exhibitions features *Islamic Science Rediscovered*, *Race: Are We So Different?*, *Goosebumps: The Science of Fear* and *The Science of Survival*.

Born in Egypt's Suez Canal Zone and then moving to England, he obtained a BSc in geology at the University of Sheffield. In 1971, he moved to Canada for his PhD in geology from the University of Ottawa. From 1986-91, he directed Alberta's Tyrrell Museum of Palaeontology with Queen Elizabeth II bestowing royal appellation upon it in 1989. From 1991-96 as CEO at the Ontario Science Centre in Toronto, a pioneer among interactive museums, he led a major facility and exhibition renewal program. In 1994, he was honored by the Government of France with a Chevalier Medal in the l'Ordre des Palmes Academique. His elected presidencies of nonprofit organizations include the Geological Association of Canada, Giant Screen Theater Association and Institute for Learning Innovation. Other current appointments include the board of the NY/NJ Metropolitan Waterfront Alliance, the US board of the International Council of Museums for the American Association of Museums, and the science-and-society committee of the American Association for the Advancement of Science.

He was recently honored by the Christopher Columbus Foundation for community service and by the American Conference on Diversity with a humanitarian award. During 2008, his invited keynote speaker roles include Washington, DC, at the Building Museums conference, at the New York State Museums Association conference in Albany, and in Bangkok at the Asia-Pacific Network of Science and Technology Centres conference. Interviewed recently by *The Wall Street Journal* for its Cultural Conversation series under the title of *Reinventing the Science Museum*, his fifty articles in the museum literature about emergent responsibilities of the field's leadership include a co-edited volume entitled *Science Centers for this Century* that has just been translated for use in China. Broadly in the museum field over the past decade, the growing consideration of what it means to be relevant has been frequently connected with the philosophy of Dr. Koster and with the practice of Liberty Science Center.

### **David Lickley**

David Lickley is a biologist turned filmmaker. He holds a Masters Degree of Science-Zoology from the University of Alberta and an Honours Bachelor of Science in Biology from Acadia University and has over 20 nature films and science

documentaries to his credit. He has nearly 20 years experience as a Producer/Director and Writer. David is currently the Director of Large Format Films for Science North, one of North America's acknowledged leaders in science education. He has won international awards for his work and has pioneered the use of an innovative multimedia technique called Object Theater. To date, David has produced four giant screen films including *Gold Fever*, *Bears*, *Jane Goodall's Wild Chimpanzees* and most recently *Mysteries of the Great Lakes* which launched on May 3, 2008 at Science North with subsequent openings scheduled throughout the U.S. David also wrote and directed a 3D 70mm film entitled *Wings over the North* a 4D exploration of the art and science of bush planes combining the 3D 70mm format and special effect seats. He is developing several new giant screen projects including *Arctic Odyssey - Journey to the Top of the World* and *Wild China — Land of the Panda*.

### **Matthew Lombard**

Matthew Lombard (Ph.D., Stanford University) is Associate Professor in the Department of Broadcasting, Telecommunications and Mass Media in the School of Communications and Theater at Temple University in Philadelphia. His research centers on individuals' psychological and physiological processing of media presentations and experiences, with particular focus on the concept of (tele)presence.

He co-founded and is president of the International Society for Presence Research (ISPR; <http://ispr.info>) and moderates the presence-I listserv, a cross-disciplinary discussion forum related to presence theory and research. He is also director of the Media Interface and Networked Design (M.I.N.D.) Lab at Temple University (<http://mindlab.org>)

His work has appeared in academic journals including *Behaviour & Information Technology*, *CyberPsychology and Behavior*, *Journal of Communication*, *Human Communication Research*, *Journal of Computer-Mediated Communication* and *Presence: Teleoperators and Virtual Environments*. For more detailed information please visit <http://matthewlombard.com>.

### **Greg MacGillivray**

Greg MacGillivray is the President of MacGillivray Freeman Films, an innovative team of specialists in the development, production and distribution of giant screen motion pictures for IMAX® Theatres. With a filmmaking career that spans more than 40 years and with more than 30 giant screen films to his credit, Greg has shot more 70mm film than anyone in cinema history. His California-based company has been dedicated to the giant screen motion picture format since the production of his first IMAX theatre film, *To Fly!*, in 1976. Twenty years later, *To Fly!* was selected by the Library of Congress for inclusion in the National Film Archives as one of the most important films in the first 100 years of American filmmaking.

Early in his filmmaking career, Greg worked in Hollywood with Stanley Kubrick on *The Shining* and for the Academy Award®-nominated *Jonathan Livingston Seagull* and the Oscar®-winning *Sentinels of Silence*.

Greg received his own first Academy Award nomination in 1995 for his giant screen ocean classic, *The Living Sea*, which was nominated for Best Documentary Short Subject. He was nominated a second time in the same category for *Dolphins* in 2000. In 1998, his blockbuster film *Everest* achieved unprecedented critical acclaim and box office success and is currently the highest grossing IMAX Theatre film in history. In September 2002, the Giant Screen Theater Association recognized Greg as one of five of the most important contributors to the success of the large format industry over the last twenty-five years. Later that year, MacGillivray accepted the Bradford Washburn Award from the Museum of Science for his contribution to science education.

### **Mary L. Nucci**

Mary Nucci is a Doctoral Candidate at the School of Communication, Information and Library Studies, and a Research Analyst at the Food Policy Institute, both at Rutgers University. Her doctoral research focuses on the role of visual format, rhetoric and culture in science communication, focusing on large format film. Her research at the Food Policy Institute focuses on television news coverage of issues relating to food and science. She has an AB in Biological Sciences from Mount Holyoke College and an MS in Zoology from Rutgers. Prior to her tenure at Rutgers, she worked at Enzon Inc., serving in a variety of positions from Immunologist to Associate Director of Scientific Information; was partner in New Paradigm Consulting Inc. specializing in science writing, project management, teaching, and curriculum development; and was Thematic Director of Health at Liberty Science Center where she and her team successfully completed and installed *Prenatal Imagery: Art from Within*, *Bodies in Motion*, and the award-winning *Live From...Cardiac Surgery*.

### **Ivan Oransky**

Ivan Oransky was previously deputy editor of *The Scientist*, *Magazine of the Life Sciences*. Under his leadership, the editorial team of *The Scientist* earned the 2006 and 2007 Gold Eddie Awards for science magazines from FOLIO, and 2008 Magazine of the Year from the American Society of Business Publication Editors (80,000 and under division). He also conceived of and edited a supplement on schizophrenia that won ASBPE's top award for supplements in 2008, and in 2007 *The Scientist* was a finalist (top 10) in the ASBPE Magazine of the Year competition.

In its first year of publication, *Praxis Post*, an online magazine of medicine and culture of which he was the founding editor, was a finalist for the 2001 Online News Association Award for General Excellence.

He has written for publications including the *Baltimore Sun*, *Boston Globe*, *Fitness*, *The Lancet*, *Salon*, *Slate*, and the *Wall Street Journal Online*. He serves on the board of directors of the Association of Health Care Journalists and as a member of the advisory board of the University of Southern California/Annenberg California Endowment Health Journalism Fellowships. He also teaches medical journalism in New York University's Science, Health, and Environmental Reporting program and at the City University of New York's Graduate School of Journalism. He is a clinical assistant professor of medicine at the New York University School of Medicine,

where he received his MD. During medical school, he served as editor-in-chief of *Pulse*, the medical student section of the Journal of American Medical Association. He completed his internship at Yale University and has a BA from Harvard.

### **Beverly Sheppard**

Beverly Sheppard is the President and CEO of the Institute for Learning Innovation, a center for learning research and evaluation in museums and other informal learning institutions. Her museum experience spans more than twenty-five years and includes positions as Acting Director of the Institute of Museum and Library Services, the federal funding agency that serves critical aspects of the cultural sector, and as President and CEO of Old Sturbridge Village in Massachusetts. Beverly is a frequent keynote speaker and writer in the museum field. She is author, with John H. Falk, of *Thriving in a Knowledge Age: New Business Models for Museums and Other Cultural Institutions* and has presented numerous workshops and conference sessions on leading change in museums. Her 1993 publication, *Building Museum and School Partnerships*, is currently being expanded to meet the changing needs of public education in our present decade.

Sheppard has played many roles in the museum community, including service on the national boards of the American Association of Museums and the American Association for State and Local History, and ongoing work as a consultant in interpretive planning and museum management. Sheppard's museum leadership has focused extensively on the museum as a center for lifelong learning, a strong community partner, and an essential force in building a civil society. She is an active proponent of establishing lifelong learning networks across our communities.

### **Phil Streather**

Principal Large Format (PLF) was founded in 1998 by present CEO Phil Streather. PLF is a production company dedicated to developing and producing: 3D/2D Giant Screen (IMAX) features, 3D/2D features and 3D TV. In 1997/8 he produced *Wildfire - Feel the heat*, for Discovery Channel Pictures and in 1999 was the producer on the groundbreaking drama, *Legend of Loch Lomond*, for Dunbartonshire Enterprise, Scotland.

His most recent Giant Screen film, *Bugs! 3D*, narrated by Judi Dench, has won many awards, including the GSCA Best Film for Learning, the prestigious Panda Award for Best Large Format Film at the Bristol Wildscreen Film Festival. *Bugs!* was also a Semi-Finalist in the Documentary Short Subject category of the 2004 Academy Awards® Competition.

In addition, PLF produced 3 short 3D films for the touring version of Andrew Lloyd Webber's hit musical, *Starlight Express* (films produced by Alexandra Ferguson and directed by Julian Napier). And, with Giant Screen producing partner Jonathan Barker of SK Films, PLF is the recipient of the largest grant made by the National Science Foundation to a Giant Screen film and outreach programme, of \$3m, for their next Giant Screen 3D film, *Flight of the Butterflies*.

Phil is also a board member of the Giant Screen Cinema Association, is a member of the GSCA's Professional Development Committee and regularly chairs/produces/participates in panels and master classes on 3D at industry conferences.

### **Jeffrey L. Sturchio**

Dr. Jeffrey L. Sturchio is Vice President, Corporate Responsibility, at Merck & Co., Inc., in Whitehouse Station, New Jersey, where he manages a portfolio of activities including Merck's corporate philanthropy, the Merck Institute for Science Education, the Merck Childhood Asthma Network, global health partnerships (including the Merck MECTIZAN Donation Program), global HIV/AIDS access programs, corporate responsibility reporting and the Merck Archives. He also serves as President of The Merck Company Foundation, a US-based, private charitable foundation established in 1957 by Merck & Co., Inc., which is Merck's chief source of funding support to qualified non-profit, charitable organizations. (In 2007, Merck made cash contributions of \$62 million, donations of medicines and vaccines -- including the Merck Medical Outreach Program and the MECTIZAN Donation Program -- of \$605 million, and donations of medicines through the Merck Patient Assistance Program of \$161 million.)

Since 2000, Dr. Sturchio has been centrally involved in Merck's participation in the UN/Industry Accelerating Access Initiative to help improve HIV/AIDS care and treatment in the developing world. He is a member of the board of the African Comprehensive HIV/AIDS Partnerships in Botswana and also a member of the private sector delegation to the Board of the Global Fund to Fight AIDS, TB and Malaria. Dr. Sturchio also serves as Chairman of the Corporate Council on Africa (an organization of nearly 200 U.S. companies representing some 85 per cent of total U.S. private sector investments in Africa).

Dr. Sturchio received an A.B. in history (1973) from Princeton University and a Ph.D. in the history & sociology of science from the University of Pennsylvania (1981). His previous positions include the AT&T Archives, the Beckman Center for the History of Chemistry at the University of Pennsylvania, Rutgers University, and the New Jersey Institute of Technology. He has also been a Postdoctoral Fellow and Senior Fellow at the Smithsonian Institution's National Museum of American History (NMAH). In 2004 he was appointed a Visiting Fellow of LSE Health and Social Care at the London School of Economics and elected a Fellow of the American Association for the Advancement of Science. He joined Merck in June 1989 as the Company's first Corporate Archivist.

His publications include *Chemistry in America, 1876-1976: Historical Indicators* (Reidel, 1985; paperback edition, 1988), written with A. Thackray, P. T. Carroll, and R. F. Bud; *Values & Visions: A Merck Century* (Merck & Co., Inc., 1991); "Pharmaceutical firms and the transition to biotechnology: a study in strategic innovation" (with L. Galambos), *Business History Review* 72 (Summer 1998): 250-278; "Against: Direct to consumer advertising is medicalising normal human experience" (with S. Bonaccorso), *British Medical Journal* 324 (13 April 2002): 910-911; "Successful public-private partnerships in global health: lessons from the

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## **Appendix 4. Symposium Registrants**

(as of August 26, 2008)

Andy Adkins, Student, Montana State University, Bozeman, Montana, United States

Therese Andrade, Vice President, Sales, IMAX Corporation, Camarillo, California, United States

Alice Apley, Research Associate, RMC Research Corporation, Portsmouth, New Hampshire, United States

Randy Atkins, Senior Program Officer, Media/Public Relations, National Academy of Engineering, Washington, District of Columbia, United States

Eliene Augenbraun, President/CEO, ScienCentral, Inc., New York, New York, United States

JoAnna Baldwin-Mallory, Director, Office of New Ventures, Partners Healthcare, Boston, Massachusetts, United States

Jonathan Barker, President and CEO, SK Films Inc., Toronto, Ontario, Canada

Anne Marie Barry, Associate Professor, Communication, Boston College, Chestnut Hill, Massachusetts, United States

Eric Bendick, Student, , Montana State University, Bozeman, Montana, United States

Claude Benoit, President and CEO, Montreal Science Centre, Montreal, Quebec, Canada

Marcia Bittner, Director of Marketing, The Maritime Aquarium, Norwalk, Connecticut, United States

Colleen Blair, Senior Vice President, Fort Worth Museum of Science and History, Fort Worth, Texas, United States

Jennifer Boxer, Director, International Initiatives, Saint Louis Science Center, St. Louis, Missouri, United States

Julie Brown, Group Sales and Marketing Manager, Worlds Biggest Screens Pty Ltd (WBS Pty Ltd), Sydney, New South Wales, Australia

Fiona Cameron, Research Fellow, Center for Cultural Research, University of Western Sydney, Penrith South, New South Wales, Australia

Diane Carlson, Vice President, Visitor Services and Theater Programs, Pacific Science Center, Seattle, Washington, United States

Lisa Cartwright, Professor, Communication and Science Studies, University of California, San Diego, California, United States

Joe Colombo, Associate Director, IMAX, Liberty Science Center, Jersey City, New Jersey, United States

Heather Danskin, Student, American University, Washington, District of Columbia, United States

Lauren Demko, Student, American University, Washington, District of Columbia, United States

Eric Dillens, Distributor, nWave Pictures Distribution, Brussels, Belgium

Jini Durr, Producer, Day's End Pictures, Inc., Culver City, California, United States

Paul Dusenbery, Executive Director, Space Science Institute, Boulder, Colorado, United States

Dave Duszynski, Vice President of Theaters, Cincinnati Museum Center, Cincinnati, Ohio, United States

Charles Dye, Student, Montana State University, Bozeman, Montana, United States

Robert Eather, Owner, KEO Consultants, Brookline, Massachusetts, United States

Lynn Ellington, Management Analyst Officer/Film Advisor, National Museum of Natural History, Washington, District of Columbia, United States

Janna Emmel, Director, MacGillivray Freeman Films Educational Foundation, Laguna Beach, California, United States

Domingo Escutia, Program Manager, Ciudad de las Artes y las Ciencias, S.A., Valencia, Spain

Cristina Ezkauriatza, Public Relation Manager, Centro De Ciencias Y Artes, A.C., San Pedro Garza Garcia, Mexico

Munro Ferguson, Animation Director, National Film Board of Canada, Saint-Laurent, Quebec, Canada

Felice Frankel, Senior Research Fellow, Initiative in Innovative Computing, Harvard University, Cambridge, Massachusetts, United States

Kelly Germain, Web Editor, Giant Screen Cinema Association, St. Paul, Minnesota, United States

Goedele Gillis, Distributor, nWave Pictures Distribution, Brussels, Belgium

Bob Griesmer, Chief Operating Officer, The Maritime Aquarium, Norwalk, Connecticut, United States

Amber Hawtin, Sales and Distribution Manager, SK Films Inc., Toronto, Ontario, Canada

Michael Henrichs, Director of Production, Greenlight Media AG, Berlin, Germany

Elizabeth Hoyos, Executive Director, Maloka Science Center, Bogota, D.C., Colombia

Fred Huebener, Chrysler IMAX Dome Theatre Manager, Detroit Science Center, Detroit, Michigan, United States

James Hyder, Editor/Publisher, LF Examiner, Columbia, Maryland, United States

Gretchen Jaspering, President, Giant Screen Cinema Association, St. Louis, Missouri, United States

Stephen Judson, Vice President, Film Production and Post Production, MacGillivray Freeman Films, Inc., Laguna Beach, California, United States

Valentine Kass, Program Director, National Science Foundation, Arlington, Virginia, United States

Katie Kassof, Student, American University, Washington, District of Columbia, United States

Don Kempf, Co-Founder, Giant Screen Films, Evanston, Illinois, United States

Steve Kempf, Co-Founder, Giant Screen Films, Evanston, Illinois, United States

Doug King, President and CEO, Saint Louis Science Center, St. Louis, Missouri, United States

Jeffrey Kirsch, President and CEO, Reuben H. Fleet Science Center, San Diego, California, United States

Tim Knapp, Vice President, Sales, Technicolor/CFI, Burbank, California, United States

Valerie Knight-Williams, Director, Knight-Williams Research Communications, Sacramento, California, United States

Emlyn Koster, President and CEO, Liberty Science Center, Jersey City, New Jersey, United States

Wayne LaBar, Vice President, Exhibitions and Featured Experiences, Liberty Science Center, Jersey City, New Jersey, United States

Cherie Larson Rivers, Director, Featured Experiences, Liberty Science Center, Jersey City, New Jersey, United States

David Lickley, Director, Large Format Films, Science North, Sudbury, Ontario, Canada

Matthew Lombard, Associate Professor, Broadcasting, Telecommunications and Mass Media, Temple University, Philadelphia, Pennsylvania, United States

Alexander Low, Producer, The Stephen Low Company, Dorval, Quebec, Canada

Nikki Lowry, Director, National Outreach, National Geographic Cinema Ventures, Washington, District of Columbia, United States

Greg MacGillivray, President, MacGillivray Freeman Films, Inc., Laguna Beach, California, United States

Barbara MacGillivray, Research Director, MacGillivray Freeman Films, Inc., Laguna Beach, California, United States

Shaun MacGillivray, Co-Producer, MacGillivray Freeman Films, Inc., Laguna Beach, California, United States

Wendy MacKeigan, Executive Producer, SK Films Inc., Toronto, Ontario, Canada

Elisabeth Mantello, Vice President, Educational Programs, 3D Entertainment Distribution Ltd., Weybridge, Surrey, United Kingdom

Ellen McCallie, Director, CAISE - Center for Advancement of Informal Science Education, Washington, District of Columbia, United States

Hooley McLaughlin, Acting Director, Visitor Experience, Ontario Science Centre, Toronto, Ontario, Canada

Toby Mensforth, Vice President, Theaters and Concessions, National Air and Space Museum, Washington, District of Columbia, United States

Lynn Morris, National Museum of Natural History, Washington, District of Columbia, United States

Glenn Newland, Director, 70 mm Operations, Technicolor/CFI, North Hollywood, California, United States

Mary L. Nucci, Doctoral Candidate, Rutgers University, New Brunswick, New Jersey, United States

Jim O'Leary, Senior Director, Maryland Science Center, Baltimore, Maryland, United States

Andrew Oran, Vice President, Sales & Operations Large Format, FotoKem, Burbank, California, United States

Ivan Oransky, Managing Editor, Online, Scientific American, New York, New York, United States

Jeffrey Osowski, Vice President, Learning and Teaching, Liberty Science Center, Jersey City, New Jersey, United States

Chris Palmer, President, MacGillivray Freeman Films Educational Foundation, Washington, District of Columbia, United States

Kurt Przybilla, Writer/Producer of Molecularium, Nanotoon Entertainment, Troy, New York, United States

Robert Russell, Science Advisor, Self-Reliance Foundation, Washington, District of Columbia, United States

Jerry Sachs, Director of Guest Services, National Museum of Natural History, Washington, District of Columbia, United States

Tammy Seldon, Conference and Meetings Director, Giant Screen Cinema Association, Lake Anna, Virginia, United States

Glenn Shaver, Associate Director, Theatre Operations, Ontario Science Centre, Toronto, Ontario, Canada

Beverly Sheppard, President and CEO, Institute for Learning Innovation, Edgewater, Maryland, United States

Bayley Silleck, President, Blue Mountain Film Associates Inc., New York, New York, United States

Harrison Smith, General Manager, MacGillivray Freeman Films, Inc., Laguna Beach, California, United States

Dava Sobel, Author, East Hampton, New York, United States

Gordon Stalans, Director of Finance, Tennessee Aquarium, Chattanooga, Tennessee, United States

Phil Streater, CEO, Principal Large Format, Somerset, United Kingdom

Jeffrey Sturchio, Vice President, Corporate Responsibility, Merck & Co., Inc., Whitehouse Station, New Jersey, United States

Sophokles Tasioulis, Producer, Sophokles Tasioulis, Berlin, Germany

Donna Tracy, Producer, OmniCosm Studios, Los Angeles, California, United States

Lisa Truitt, President, Cinema Ventures, National Geographic, Washington, District of Columbia, United States

Carol Valenta, Senior Vice President, Saint Louis Science Center, St. Louis, Missouri, United States

Bill Watson, Chief, Onsite Learning Venues, National Museum of Natural History, Washington, District of Columbia, United States

Ron Wengler, Chief Color Timer, Technicolor/CFI, North Hollywood, California, United States

Shari Werb, Director of Education and Outreach, National Museum of Natural History, Washington, District of Columbia, United States

## Appendix 5. Expectations of Symposium Registrants

### What experience and knowledge would you contribute?

*What follows are the responses, edited slightly in some cases for format consistency, to the above first question that was asked when registering for this Symposium.*

- I participated in the GSTA symposium *Giant Screen Films and Lifelong Learning* ten years ago, and look forward to this symposium as a chance to assess the current state of the industry and discuss future directions and strategies to enhance lifelong learning.
- Production and distribution oversight for giant screen films for ten years. I also oversee development of films, including working with clients/sponsors and scriptwriters.
- I have edited 20 giant screen films, and have also directed and written the scripts for several giant screen films. I have worked with audiences extensively while our films are being edited to gain a perspective on their perception of the film experience. I have also worked with many science advisors on a range of science topics as a film is being developed and edited.
- I have a doctorate in life and a minor in common sense: twice married, five children, ten grandchildren, and 42 years at CFI Technicolor.
- 30 years in the imaging business assisting documentarians in many capacities.
- We are a science and technology museum and IMAX dome theater and I have been working for 30 years. We have a different experience being in Mexico, working for Latin American people.
- 25 years experience as a producer, exhibitor and educator, and I am now trying to organize a new collaborative for IMAX dome theaters.
- 25 years of experience in the large-format industry, ten of which have been in a senior product/programming responsibility.
- Science background and a 25+ year science center career. Extensive knowledge of the IMAX theater industry.
- I have been involved in the large-format film industry since 1988 as an executive director, theater director, consultant, and now, funder.

- 20 years in running of an IMAX theater for an institution that has had an average annual school attendance of 100,000. It is dropping; we need to identify how we turn this around and position our IMAX as a significant value added to the decision to visit the Aquarium.
- Over the past 20 years, I have been the leader of a number of major international exhibitions that have featured topics that deal with the connections between science and society (e.g. *A Question of Truth*). I have also worked with science centres and museums in a number of countries dealing with this subject matter. I can bring ideas that will help in the future development of film products. I will also be representing both the public and educational functions of the Ontario Science Centre, one of the world's largest science centers, at the symposium.
- 20 years of experience with one IMAX cinema.
- 18 years as a giant screen exhibitor; 30 years as informal science educator, including 15 years as a planetarium educator.
- 15 years experience in senior management of world's largest freshwater aquarium.
- 15 years of giant screen theater network experience with intimate knowledge of exhibitor needs.
- 12 years experience in senior management of giant screen theater.
- Engineering background. Ten years experience in science communication at a science museum and IMAX theatre in charge of operations and of public programs.
- Experience and as a professional educator and as a film industry producer and artist.
- I am the director of an international science center network founded by the St. Louis Science Center to bring cutting edge science to our visitors as it is happening. As part of this initiative, I write science education materials for all ages to accompany giant screen films.
- I will share our experience using the theatre as a place where fun lifelong learning is the main characteristic. Using this tool, we contribute to society, generating scientific and technological knowledge and a critical opinion among citizens.
- Our mission is to support education and try to increase in our visitors the interest on science and technology.

- Multiple years and experiences in museum education.
- I have been a co-producer of one IMAX film, *SolarMax*, about Earth's upper atmosphere and the Sun. I was also involved in the IMAX film *The Discoverers* as one of the featured scientists. I have designed and built my own camera, which was the main one used for *SolarMax*: it is one with many unique features relevant to science documentary topics.
- Producer/director/writer of seven giant-screen productions on nature, space, human brain, energy, etc.
- I am the PI on a number of NSF and NASA funded traveling exhibits including *MarsQuest*, *Alien Earths*, and *Giant Worlds*. I have many years experience in developing informal science education programs including exhibits, interactive websites, and workshop programs.
- Motion picture post production.
- Experience in evaluation of informal science education projects and specific experience in conducting front-end evaluation of giant screen films with an academic background in developmental psychology. I will write a lengthy summary of the symposium for *The Informal Learning Review* newsletter.
- Broad range of education programs that are linked to societal issues, such as energy and climate.
- As writer and producer of an innovative animation for the giant screen that presents and teaches a wide variety of scientific concepts in a fun way, I can contribute what I learned in the process.
- Experience working closely with some of the top science institutions in the world.
- Currently working on a series of films in development called *Sustainable Planet* as well as working on the film *Molecules to the MAX*.
- As the co-screenwriter of several of our large-format underwater documentaries and co-author of all related educational materials, I can contribute my extensive knowledge of the critical state of the world's oceans today and its inhabitants.
- I have produced and distributed several educational large-format films. I also have a prior background as a junior high and high school educator.
- The challenge of being a distributor to this market is dealing with new technologies almost every day and trying to keep up with these changes.

- IMAX theatre manager at a science center that exclusively shows educational (minus *Santa Versus the Snowman*) giant screen films. I have worked closely with our education department director to coordinate educational activities on the floor and bring special exhibits related to film content.
- As a long time commercial television producer and NSF award recipient, I know how to use popular formats and slip in high quality science. My most well-known project is putting current science research onto local commercial TV newscasts through ABC and NBC news networks.
- As a producer and distributor of a variety of large-format films, I hope to bring some breadth of experience to the symposium.
- Our film – *Jane Goodall's Wild Chimpanzees* – is one of the films being discussed.
- Marketing IMAX films and their educational content to educators.
- Innovative thinking.

### **What Do You Expect To Gain Professionally?**

*What follows are the responses, edited slightly in some cases for format consistency, to the above second question that was asked when registering for this Symposium.*

- I am looking forward to dialogue between producers, exhibitors and distributors.
- Each film project and each museum/theater is unique but is there a strategic approach that would make the most of the educational possibilities of a project throughout the whole chain of development, production, distribution and exhibition?
- A broader view of how science can be integrated into our industry from the giant screen to other media offerings that complement a film release.
- As a filmmaker striving to produce films that can have a meaningful and positive impact on society, I expect this symposium to provide valuable insights into how to best leverage the significant potential of the large-format medium.
- A better understanding of how I can improve science film making for the Smithsonian Institution.

- As a member of the steering committee for the Center for the Advancement of Informal Science Education (CAISE), I wish to learn of new directions and initiatives that are being launched in the area of science and society and how film production and programming might augment those efforts.
- Inputs on the best way to present scientific content to general audiences with the goal of stretching their minds rather than talking down to them. I am also interested to evaluate the common scenario of using a child in a story line.
- Since the National Science Foundation is funding this symposium, I view it as a "site visit."
- What new film ideas are out there and how to make them presentable to the average public.
- Insight into how to make giant screen films a more integral part of mission accomplishment.
- Exposed to giant screen film production all of my life, I look forward to exploring the topic of lifelong learning with others in the industry, especially as it relates to scriptwriting and how to tell science stories that will be entertaining for audiences.
- A better understanding of how dome screens can work educationally and how to take advantage of hemispherical geometry.
- Insights on working with institutions and developing working relationships.
- I believe connecting society with science can best be achieved through international collaboration among peers. I hope that we will learn from each other by sharing successes and failures from all over the world and working together to benefit the general public.
- Understand key issues about the greater educational potential of giant screen film experiences and skills for the communication of science to increase my professional development and find new strategies that can continue to grow our center.
- A deeper understanding of how to program our theater around current science issues.
- Greater understanding of best practices in conceiving and producing giant screen films that foster strong learning experiences in target audiences at institutional theaters.

- I am very interested in learning more about the role that giant film experiences can play in the public understanding of science. I would also like to look for synergies between giant screen films, exhibitions and education programs for staff.
- A better understanding of the vast educational potential that we have and how to turn this potential into reality.
- How the large format can diversify the content of established fundamental science topics to embrace the cutting-edge topics of our day – global warming, the environment and sustainability – and the role science and media will play in informing the world.
- A better understanding of the 70mm science production community. At Technicolor in Hollywood, I am operationally responsible for technical and logistical production, and need to better comprehend the challenges.
- I expect to learn about current issues regarding giant screen film and learning, and will gather information for a lengthy article on the symposium in *The Informal Learning Review*.
- Concrete ways to implement programs that will lead to action based on science.
- A better understanding of how to engage and inspire youth and future generations to become more involved in science and sustainable practices.
- I am interested in the research being done in the communication of science and promoting it to the public as well as how this is affecting the development of giant screen films.
- As the distributors of *Molecules to the MAX*, any new insight as to how we can bring the real science fact aspects of the film to a broader audience will be very helpful. This project involves working with the nano science technology department at Rensselaer Polytechnic Institute.
- I am interested in attending the symposium because it will be productive to hear different proposals to improve our dome theatre, the first one in Latin America, as a tool that can help us develop our main goal – the social appropriation of science, technology and innovation.
- Insight into how to better position IMAX films with the educational community in order to promote student group attendance.
- I would hope to gain further insight into means of effectively communicating scientific facts and educational messages through film and ancillary activities.

- Further insight on ideas as to how filmmakers and exhibitors can work together to produce excellent films that combine learning and fun.
- Looking for creative ways to integrate science education into the museum world in general and giant screen films in particular.
- I will meet other professionals who are hoping to link exhibitions with film products in order to enhance the public understanding of science. I expect that partnerships and potential future ventures could be seeded at the symposium.
- To learn how distributors and theaters handle continuous technical change.
- I am looking to expand the use of current research video onto other platforms, and giant screens seem like a great way to do it.
- Learn about new trends in IMAX as a real tool for science communication and meet new business contacts.
- Learn new and better ways to take the educational content of the films we show into the other work that we do. Also, learn additional ways to excite and involve the public in the content of our films.
- A better understanding of the best possible learning experiences that can add value to the giant screen experience.
- I hope to better inform our film development focus, film production objectives and the direction of collateral materials.

## Appendix 6: Chronological list of Giant Screen Films, 1970-2008

(Courtesy of James Hyder, *LF Examiner*)

Title	Release Date	Origin	Running Time
Tiger Child	1970	1570	16
North of Superior	1971	1570	18
Volcano	1973	1570	7
Voyage to the Outer Planets	1973	1570	
Garden Isle	1973	1570	11
Catch the Sun	1973	1570	22
Standing Up Country	1973	1570	22
Snow Job	1974	1570	17
Man Belongs to the Earth	1974	1570	23
Cosmos	1974	1570	33
Circus World	1974	1570	25
Energy	1975	1570	24
Viva Baja	1975	1570	11
To Fly!	1976	1570	27
Rivers of North America	1976	1570	24
American Years	1976	1570	48
Ontario Summertime	1976	1570	21
Ocean	1977	1570	25
Silent Sky	1977	1570	18
Alfa 78	1978	1570	26
Nomads of the Deep	1979	1570	20
Genesis	1979	1570	33
Living Planet	1979	1570	30
Atmos	1980	1570	27
Eruption of Mount St. Helens, The	1980	1570	21
My Strange Uncle	1981	1570	32
Great Barrier Reef, The	1981	1570	47
American Adventure, An	1981	1570	25
World Coaster	1981	1570	20
Flyers	1982	1570	33
Energy! Energy!	1982	1570	27
Hail Columbia!	1982	1570	36
Tomorrow in Space	1982	1570	33
Behold Hawaii	1983	1570	39
Darwin on the Galapagos	1983	1570	47
People of the Sun	1983	1570	25
Magic Egg, The	1984	1570	15
Omninews	1984	1570	8
Speed	1984	1570	30
Dance of Life	1984	1570	26

Faces of Japan	1984	1570	30
Journey of Discovery	1984	1570	21
River Journey	1984	1570	15
Grand Canyon: The Hidden Secrets	1985	1570	36
Chronos	1985	1570	42
Skyward	1985	1570	24
Water and Man	1985	1570	37
Dream is Alive, The	1985	1570	37
We Are Born of Stars	1985	1570	11
Freedom to Move, A	1985	1570	24
Sacred Site (aka NOTC)	1986	1570	7
On The Wing	1986	1570	33
Dance of the East	1986	1570	40
Picture Holland	1986	1570	15
Transitions	1986	1570	21
Primiti Too Taa	1987	1570	3
Weaving Ants	1987	1570	12
Hawaii, Born in Paradise	1987	1570	35
Seasons	1987	1570	32
Heart Land	1987	1570	37
Island Child	1987	1570	27
New England Time Capsule	1987	1570	5
Niagara: Miracles, Myths, and Magic	1987	1570	40
Emergency	1988	1570	35
Time Concerto	1988	1570	11
Beavers	1988	1570	30
Deepest Garden (aka Benthos)	1988	1570	35
Alamo: The Price of Freedom	1988	1570	41
Philadelphia Anthem	1988	1570	7
Race the Wind	1989	1570	39
From A Little World	1989	1570	30
I Write in Space	1989	1570	42
Only the Earth	1989	1570	17
To The Limit	1989	1570	38
Hydro	1989	1570	5
Sea Fantasy	1989	1570	17
First Emperor of China, The	1989	1570	40
Last Buffalo, The	1990	1570	27
Black Widow	1990	1570	
Flowers in the Sky	1990	1570	15
Echoes of the Sun	1990	1570	20
Flying Raft	1990	1570	20
Blue Planet	1990	1570	42
Creatures of the Season	1990	1570	22
Homeland	1990	1570	21
Emeralds of the Sea	1991	1570	32
Rolling Stones: At the Max	1991	1570	89

Light and Life	1991	1570	35
Praying Mantis	1991	1570	
Ring of Fire	1991	1570	38
Antarctica	1991	1570	38
Polynesian Odyssey	1991	1570	42
Switzerland	1991	1570	35
Flight of the Aquanaut	1992	1570	35
Top Chrono	1992	1570	3
Mountain Gorillas	1992	1570	30
Search for the Great Sharks	1992	1570	38
Tropical Rain Forest	1992	1570	39
Hidden Hawaii	1992	1570	34
To Be An Astronaut	1992	870	23
Titanica (long)	1992	1570	95
Fires of Kuwait	1992	1570	36
Momentum	1992	1570	20
Taiwan	1992	1570	40
Lost Animals	1992	1570	
Discoverers, The	1993	1570	40
Destiny in Space	1993	1570	40
Ozarks: Legacy and Legend (aka Fiddle)	1993	1570	40
Welcome to the Max	1993	1570	12
Yampa: The Untamed River	1993	1570	6
Breaking Through	1993	1570	
Dream of Flight	1993	1570	40
Journey to the Planets	1993	ANI	16
Reach for the Sky	1993	1570	18
Africa: the Serengeti	1994	1570	39
Heartsong	1994	870	20
Zion Canyon (aka TOTG)	1994	1570	38
Yellowstone	1994	1570	35
Wings of Courage	1994	1570	40
Ant's Dream of the Sea, An	1994	1570	20
Flower Planet	1994	1570	9
Imagine	1994	1570	22
Journey Inside, The	1994	1570	40
Neighbors	1994	1570	5
Viva La Blanca Paloma	1994	1570	23
Into the Deep	1994	1570	35
Living Sea, The	1994	1570	39
Across the Sea of Time	1995	1570	51
Story of Winds, The	1995	1570	40
Green Contract	1995	1570	25
Storm Chasers	1995	1570	38
Mystery of the Maya	1995	1570	38
Survival Island	1995	1570	35
Imagine Indiana	1995	1570	6
Philadelphia Symphony	1995	1570	6
Shinsyu Symphony	1995	1570	35

Cosmic Voyage	1996	1570	35
Hearst Castle: Building the Dream	1996	870	39
Urushi	1996	1570	
Whales	1996	1570	40
Secret of Life on Earth, The	1996	1570	42
L5: First City in Space	1996	1570	35
Special Effects	1996	1570	40
Dallas: A Unique Place in Time	1996	1570	6
Great American West, The	1996	1570	40
Island Adventure	1996	1570	40
Mexico	1996	1570	40
Piliialoha	1996	1570	32
Symphony Philadelphia	1996	1570	5
Super Speedway	1997	1570	48
Mission to Mir	1997	1570	40
Magic of Flight, The	1997	1570	39
Wild Australia: The Edge	1997	1570	40
Alaska: Spirit of the Wild	1997	1570	40
Amazon	1997	1570	38
Thrill Ride	1997	1570	40
Hidden Dimension (aka FMHG)	1997	1570	39
Chatrer les Porcs Pour Une Meilleure Plus Value	1997	8mm	1
Fire	1997	1570	2
Mars Makeover	1997	1570	1
IMAX Nutcracker, The	1997	1570	40
Paint Misbehavin'	1997	ANI	2
Dear Blue	1997	1570	
Dino Planet	1997	1570	
Greatest Places, The	1998	1570	40
Everest	1998	1570	44
Sedona: The Spirit of Wonder	1998	1570	33
Africa's Elephant Kingdom	1998	1570	40
Mark Twain's America	1998	1570	51
Mysteries of Egypt	1998	1570	40
Shirakami Mountains, The	1998	1570	40
T-Rex: Back to the Cretaceous	1998	1570	40
More	1998	1570	6
Way to B, The	1998	1570	25
Passion for Life	1998	1570	8
Olympic Glory	1999	1570	40
On Guard	1999	1570	20
Encounter in the Third Dimension	1999	CGI	40
Spirit of American	1999	1570	40
Wolves	1999	1570	40
Wildfire: Feel the Heat	1999	1570	40

Extreme	1999	1570	44
Island of the Sharks	1999	1570	40
East End	1999	VID	4
Master Positive	1999	1570	5
Old Man and the Sea, The	1999	1570	40
Gold Fever	1999	1570	40
Maximum Velocity	1999	1570	6
Klassiker	1999	1570	10
Alien Adventure	1999	CGI	40
Sydney: Story of a City	1999	1570	40
Chang Jiang: The Great River of China	1999	1570	40
Siegfried and Roy: The Magic Box	1999	1570	50
Amazing Journeys	1999	1570	40
Galapagos	1999	1570	40
Cirque du Soleil: Journey of Man	1999	1570	38
Spirit of Silicon Valley, The	1999	1570	7
Fantasia/2000	2000	ANI	77
Ultimate G's: Zac's Flying Dream	2000	870	40
Dolphins	2000	1570	40
Michael Jordan To the Max	2000	1570	46
Adventures in Wild California	2000	1570	40
Pandorama	2000	1570	3
Rheged: The Lost Kingdom	2000	1570	40
Solarmax	2000	1570	40
Ocean Oasis	2000	1570	40
Great North	2000	1570	40
Cyberworld 3D	2000	CGI	40
Ski to the Max	2000	1570	40
Straw That Breaks the Camel's Back...?, The	2000	1570	16
Majestic White Horses, The	2001	1570	40
'N Sync: Bigger than Live	2001	870	45
Shackleton's Antarctic Adventure	2001	1570	40
Haunted Castle	2001	CGI	40
Journey into Amazing Caves	2001	1570	40
All Access	2001	1570	64
Lost Worlds: Life in the Balance	2001	1570	40
Princess and the Pea, The	2001	1570	6
China: The Panda Adventure	2001	1570	40
Origins of Life	2001	1570	40
Bears	2001	1570	40
Ocean Men	2001	1570	40
Human Body, The	2001	1570	40
Celebrate Detroit	2001	1570	5

Indonesia Indah IV	2001	1570	40
Pittsburgh's Big Picture	2001	1570	9
Beauty and the Beast	2002	ANI	94
Legend of Loch Lomond, The	2002	1570	38
In Five Minutes, The Feature	2002	1570	6
Vulcania	2002	870	20
Kilimanjaro	2002	1570	40
Space Station	2002	1570	40
Lewis & Clark: Great Journey West	2002	1570	40
Jane Goodall's Wild Chimpanzees	2002	1570	40
Ultimate X	2002	1570	50
Australia: Land Beyond Time	2002	1570	40
Horses: The Story of Equus	2002	1570	40
India: Kingdom of the Tiger	2002	1570	40
Skydance	2002	1570	40
One Night In My Dreams...	2002	1570	2
Straight Up: Helicopters in Action	2002	1570	40
Apollo 13: The IMAX Experience	2002	DMR	115
Adrenaline Rush	2002	1570	40
Pulse: A Stomp Odyssey	2002	1570	40
SOS Planet	2002	CGI	40
Santa Vs. The Snowman	2002	CGI	40
Star Wars Episode II: The IMAX Experience	2002	DMR	120
Treasure Planet	2002	ANI	90
Home of Freedom	2002	1570	7
Lion King, The	2002	ANI	90
Ocean Wonderland 3D	2003	HDV	44
Coral Reef Adventure	2003	1570	40
Bugs!	2003	870	40
Legend of the Forest: Special Edition	2003	ANI	40
Top Speed	2003	1570	40
Ghosts of the Abyss	2003	HDV	60
Texas: The Big Picture	2003	1570	40
Where the Train Used to Go	2003	1570	5
Falling in Love Again	2003	ANI	3
Country Music: The Spirit of America	2003	1570	40
Matrix Reloaded: The IMAX Experience, The	2003	DMR	138
Volcanoes of the Deep Sea	2003	1570	40
Stage Fright	2003	1570	2
Misadventures in 3D	2003	CGI	40
Matrix Revolutions: The IMAX Experience, The	2003	DMR	129

Roar: Lions of the Kalahari	2003	35	40
Young Black Stallion, The	2003	1570	50
NASCAR 3D: The IMAX Experience	2004	1570	40
Hubble: Galaxies Across Space and Time	2004	CGI	3
Voyagers of Sky and Sea	2004	1570	16
Sacred Planet	2004	1570	40
Better Mousetrap, A	2004	CGI	2
Forces of Nature	2004	1570	40
Harry Potter and the Prisoner of Azkaban	2004	DMR	141
Next Stop Mars	2004	CGI	25
Spider-Man 2: The IMAX Experience	2004	DMR	127
Vikings	2004	1570	40
Persistence of Dreams, The	2004	1570	3
Polar Express: An IMAX 3D Experience, The	2004	DMR	99
Fighter Pilot: Operation Red Flag	2004	1570	40
Adventures in Animation 3D	2004	CGI	37
Sharks 3D	2004	HDV	42
Aliens of the Deep	2005	HDV	47
Mystic India	2005	1570	40
Mystery of the Nile	2005	1570	40
Robots: The IMAX Experience	2005	DMR	91
Wild Safari 3D	2005	35	40
Astro Boy versus IGZA	2005	35	40
Batman Begins: The IMAX Experience	2005	DMR	141
Charlie and the Chocolate Factory	2005	DMR	106
Magnificent Desolation	2005	1570	40
Legend of the White Horse	2005	ANI	14
Harry Potter and the Goblet of Fire	2005	DMR	150
Wired to Win	2005	1570	40
Roving Mars	2006	1570	40
Greece: Secrets of the Past	2006	1570	40
Explorers Club	2006	CGI	5
Deep Sea 3D	2006	1570	40
V For Vendetta: The IMAX Experience	2006	DMR	120
Poseidon: The IMAX Experience	2006	DMR	120
Ride Around the World	2006	1570	44
Superman Returns: An IMAX 3D Experience	2006	DMR	120

Ant Bully: An IMAX 3D Experience, The	2006	DMR	90
Open Season: An IMAX 3D Experience	2006	DMR	120
Happy Feet: The IMAX Experience	2006	DMR	90
Night at the Museum: The IMAX Experience	2006	DMR	120
Hurricane on the Bayou	2006	1570	40
African Adventure 3D	2007	35	40
Mummies: Secrets of the Pharaohs	2007	1570	40
300: The IMAX Experience	2007	DMR	120
Alps: Giants of Nature, The	2007	1570	40
Dinosaurs 3D: Giants of Patagonia	2007	1570	40
Dinosaurs Alive	2007	1570	40
Spider-Man 3: The IMAX Experience	2007	DMR	120
Galaxy Express 999	2007	ANI	32
Harry Potter and the Order of the Phoenix	2007	DMR	120
Pikachu's Ocean Adventure	2007	ANI	14
Space Elevator	2007	ANI	32
Scarecrow, The	2007	ANI	5
Transformers: The IMAX Experience	2007	DMR	145
Moon Man	2007	ANI	3
Sea Monsters: A Prehistoric Adventure	2007	1570	40
Beowulf: An IMAX 3D Experience	2007	DMR	120
I Am Legend: The IMAX Experience	2007	DMR	120
Really Big Short Film Festival, The	2007	1570	40
U2 3D	2008	HDV	85
Spiderwick Chronicles: The IMAX Experience, The	2008	DMR	120
Dolphins & Whales 3D	2008	HDV	40
3D Sun	2008	CGI	22
Wild Ocean	2008	1570	40
Grand Canyon Adventure	2008	1570	40
Shine A Light: The IMAX Experience	2008	DMR	120
Mysteries of the Great Lakes	2008	1570	40
Speed Racer: The IMAX Experience	2008	DMR	120
Kung Fu Panda: The IMAX Experience	2008	DMR	90

Dark Knight: The IMAX Experience, The	2008	DMR	120
Fly Me to the Moon	2008	CGI	90
Animalopolis	2008	1570	25
Proud American	2008	1570	100
Eagle Eye: The IMAX Experience	2008	DMR	120
Molecules to the Max: A Molecularium Adventure	2008	CGI	40
Madagascar: Escape 2 Africa, The IMAX Experience	2008	ANI	90