International Math Outreach Workshop

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1 Introduction

Valuable and innovative mathematical outreach activities are being held all over the world and have proven to be successful in creating interest in mathematics and spreading awareness of its importance to society. However, despite the international nature of mathematics, the majority of outreach activities never cross the borders of the countries where they are initiated, and in some cases never go beyond their immediate local community. Many of these outreach activities may be beneficial to audiences in other countries, and it is in everyones interest to find ways to share our resources and expertise and create the means for wider dissemination of successful outreach efforts.

In November 2015, a group of 18 mathematics outreach specialists converged at the Banff International Research Station (BIRS) in Alberta, Canada, for an international math outreach workshop. The participants included academic faculty from both local and world-renowned institutes and universities, graduate students, program directors, journalists, and filmmakers. Coming from Australia, Canada, Denmark, France, Germany, the United Kingdom and the United States, they presented examples of their outreach work and engaged in lively discussions about future international collaboration. Participants provided a variety of perspectives and expertise; the spectrum of nationalities further contributed to the richness and diversity of experiences and initiatives on display. Cedric Villani, Fields Medalist, joined the conversation through Skype; he explained his view of the importance of reaching outside the mathematics community and talked about his own involvement in outreach. Also joining us through Skype was Andreas Daniel Matt, from the *Mathematisches Forschungsinstitut Oberwolfach*, who shared his experience in visual and interactive mathematics, media and human in general.

The explicit purpose of the BIRS Workshop was to bring together a number of leaders in mathematics outreach from across the world, as well as those interested in discussing the aims and intricacies of mathematics outreach from an international perspective. Throughout the workshop the participants discussed how sharing ideas could benefit the global outreach paradigm. They became convinced of the need to develop an international networking infrastructure for outreach, and explored both the possibilities of expanding existing activities and creating new ones.

One theme that clearly emerged from the discussions is that outreach initiatives across the world have much in common (most notably, goals and inspiration). They also face similar challenges, such as recognition of the involvement of researchers/professors from academic institutions, and the realization by policy

makers and journalists of the importance of mathematics. Workshop participants compared strategies and solutions for addressing these challenges as they sought to define ways to expand outreach initiatives (with particular attention to gender issues and to the developing countries), facilitate cross-country collaborations, and introduce a certain level of international coordination.

Attendees addressed the many important reasons for conducting mathematical outreach, from a simple desire to inspire people to share a love of mathematics, to the need to spread recognition in the wider public and among policy makers of the importance of mathematics in our general understanding of crucial questions for our societies (climate change, limited supply of fossil fuel, etc.). Discussion rapidly led the participants to understand the need:

- to join forces to develop international strategies to eliminate false perceptions about mathematics;
- to better exploit the imagination and ingenuity of many ongoing local outreach efforts by sharing resources on the international scene;
- to organize mathematics outreach meetings, and pool forces around a new international mathematics outreach initiative;
- to develop mathematics outreach activities in the developing world;

In the remainder of this report, we discuss some of the global goals of mathematical outreach, give highlights of interesting specific outreach efforts in various countries represented at the workshop (making no attempt at being exhaustive, but rather reflecting the involvement of workshop participants), and end with a discussion of plans for a new initiative: *Mathematics Outreach International* (MOI).

2 Why mathematical outreach is important

Mathematics is an intricate part of everyday life. This is not well understood by large portions of the general public, or by policy makers, students, and teachers. Mathematical outreach efforts aim to foster favorable attitudes towards mathematics and to developing a broader awareness of mathematical culture by promoting an understanding of the fundamental role of mathematics in the world. Outreach efforts also seek to enhance the enjoyment of the learning of mathematics.

We know that mathematics is a way for people to access and develop skills such as critical thinking, problem solving and perseverance, and that outreach has the ability to convey solid role models for careers in science, technology, engineering, and mathematics (STEM). It is therefore important that outreach efforts also be aimed at under-represented groups in education known to disengage with mathematics (and other STEM disciplines) at a higher rate than the rest of the community.

Institutions of higher education strive to advance learning and to create and disseminate knowledge in society. Thus outreach to the public, to students, and to teachers is an essential component of this mission. Universities then must be among the principal actors in outreach efforts. However, outreach is also a responsibility of the whole mathematical community. There are still too many people who mistakenly envision mathematics as a dead science (in the sense that everything which needed to be discovered in mathematics has already been discovered), or who regard mathematics as a science either reserved for the elite, or something incredibly difficult and therefore not accessible to everyone. Others simply doubt the relevance of mathematics to the daily lives of most people. By joining forces in outreach initiatives, the mathematical community can develop strategies to eliminate these false perceptions and increase appreciation for mathematics and for its fundamental role in culture and society. Specific outreach efforts may vary significantly in terms of their intended audience as well as their goals. To emphasize the variety, we present some of the outreach initiatives that were outlined and discussed at the BIRS workshop.

3 Fostering talent - competitions and intensive programs

Many countries have a culture of mathematical competitions aimed at fostering talent, with some of the best culminating in participation in the *International Math Olympiad* (IMO). Other kinds of competitions exist, where the focus is on long-term collaborative work rather than on test-taking, bringing them closer to a real

research experience. Some are multidisciplinary, like the US based *Intel Science Talent Search*, the German *Jugend Forscht* or the European *Union Contest for Young Scientists*. Others are purely mathematical, like the *International Tournament of Young Scientists* (ITYM), and its national counterparts: the French *Tournoi Français des Jeunes Mathématiciens*, the Quebec tournament organized by the *Association Québécoise des Jeux Mathématiques* and the very recent Brazilian *Torneos de Matemáticas para Jóvenes*.

Other programs also aim at developing mathematical talent locally, focusing on research more than on competition. For example, the *Program in Mathematics for Young Scientists* (PROMYS) at Boston University provides a six-week immersive research experience for mathematics majors, high school students, and teachers. In its 27-year history, the PROMYS program has had a remarkable impact on developing mathematical habits of mind in its participants: 277 PROMYS alumni, including 70 women, have, or are currently working on, a PhD in mathematics. In Europe, the Russian Summer School *Contemporary Mathematics* in Dubna has been organized since 2001; a similar program, *Modern Mathematics*, has been held in Bremen or Lyon every year since 2011.

3.1 Discovering new mathematical talent

Engaging students directly in mathematics is a powerful strategy, one that is used by many for sharing mathematics with society. Research shows that often students who struggle in standard classroom settings may come alive and prosper in informal mathematical activities. Math fairs play an exceptional role in generating enthusiasm towards mathematics. Notable examples include the *National Math Festival* and the *Gather4Gardner* conference in the United States. In France, the *Math en Jeans* program organizes research projects for middle and high school students which are mentored by a research mathematician. Online platforms containing free resources for potential hosts of (both recreational and broad culture) mathematical events are flourishing in many countries. An example is the *Celebration of Mind* website, which provides a repository of intriguing mathematical activities (toys, puzzles, magic tricks and games) for teachers, students, parents and math-enthusiasts of all ages, or the IMAGINARY participatory project and website, hosting exhibitions and other mathematics material.

A number of specialized mathematics museums have been created around the world, like the *Mathematikum* in Giessen, Germany, the *National Museum of Mathematics* (MoMath) in New York, USA, the *Giardino di Archimede* in Florence, Italy, and many others. Organized visits by school children to those museums have demonstrated their impact.

3.2 Fostering in-depth or sustained engagement

Frequent sessions of mathematical investigations are key to engage young math enthusiasts in a process of mathematical discovery, which also promotes a deeper understanding of mathematics. Originating in the Eastern European tradition, these activities are currently organized on a weekly or monthly basis throughout the world (under the name of *Math Circles* in the US and Eastern Europe, *Math Masterclasses* in the UK, *Circles* or *Clubs* in France, and so on). Such programs promote independence and creativity within a supportive community.

3.3 Fostering social justice - democratizing access to mathematics

In mathematics related studies and careers, some groups participate at a much lower rate than others. Examples include indigenous communities, students from language backgrounds other than the predominant language of a country, and young people from low socio-economic backgrounds. Engaging these traditionally under-represented groups in mathematical outreach initiatives can boost their participation in higher education and STEM careers.

The University of California at Irvine (UCI) *Math CEO* (Community Educational Outreach) is an outreach program aimed at under-served youth, with the dual scope of encouraging children to attend college and providing the mathematical and critical thinking skills necessary to succeed. About 100 middle school students from local disadvantaged communities visit UCI weekly after school to work on original, thought-provoking mathematics curriculum in a small group setting together with a team of UCI faculty and students. The same kids, along with their parents, participate in a STEM-day at UCI to learn about the fascinating

research taking place "just down the road", explore careers in STEM, and get a taste of college life. Additional parents meetings are hosted at local schools to provide parents with information concerning college opportunities and financial aid for their kids; because the schools are 98% Hispanic, all the communication is provided in both English and Spanish. The *San Francisco Math Circle* is another example of a program aimed at urban youth. In France, contrary to the US, the majority of socially disadvantaged families live in the suburbs; the *MathC2+* program organizes math camps geared towards these suburban youths.

3.4 Addressing gender issues

Mathematics remains a predominantly male profession in most countries, and the same is true for many STEM career paths. The adverse effect of gender stereotypes of mathematics performance has been clearly demonstrated. Specific programs have been developed to address gender issues in mathematics, like the *Girls and mathematics, a shining equation* day events organized in France.

The participation of girls in national and international olympiads is low. To address this problem, specific competitions for girls, like the *European Girls' Mathematical Olympiad* (EGMO), have been created. However, gender imbalance remains a great source of preoccupation; perhaps a diversification of the kinds of competitions offered could provide a remedy.

3.5 Mathematics outreach in developing countries

By the end of the 21st century, it is expected that nearly half of all babies will be born in Africa. The challenge of providing a good STEM education in developing countries is tremendous. For similar reasons as in affluent countries, getting students interested in mathematics cannot wait until they reach college. Some instruments successfully used in affluent countries (math circles and clubs, competitions, mathematics exhibitions) should be fostered in developing countries as well, with help provided by mathematicians and mathematics educators from around the world.

4 Increasing mathematical literacy among policy makers and citizens alike – tools to popularize mathematics

It is recognized that mathematics plays a fundamental role in our society and culture, here considered in the broad sense to include art, literature, and science. It may be unclear to many that this is because mathematics aims to develop clear and precise abstract concepts that structure our thinking, as well as to explore how these abstract concepts interact, while studying and characterizing their essential properties. Thus, mathematics provides the necessary tools for scientific thought to unfold and be made concrete. It can be argued that most obstacles to a better scientific understanding of natural and human-caused phenomena, correspond to a lack of adequate mathematical tools. In short, a solid grasp of basic mathematical notions is necessary for most scientific endeavors, as well as to understand many current socio-environmental issues. For example, the impossibility of sustaining exponential growth in a context of limited resources is certainly pertinent to the understanding of the concrete limits of our continued use of fossil fuels. This is just one example of the many ways in which an objective mathematical appreciation of a situation can be helpful to policy makers and citizens alike. Other examples include an assessment of risk in health or the impact of social decisions.

Tools for popularizing mathematics include websites, classroom materials, films and books about mathematics and mathematical personalities, theatrical performances, public lectures by prominent mathematicians, radio and television programs, and exhibitions at museums and in other public settings. We discuss two films that were shown during the BIRS workshop in more depth here.

The first, a screening of Olivier Peyon's prize-winning 2013 feature documentary *Comment j'ai détesté les maths* (*How I came to hate math*) sets out to display the public's ambivalence to mathematics, and goes on to present the importance of the subject to various human activities, particularly finance. Celebrity mathematicians such as Jean-Pierre Bourguignon, Robert Bryant, Jim Simons, and Cedric Villani are summoned at various points of the movie to convey their thoughts on the relevance of mathematics in everyday life, and to shed light on the beauty of this field and its role in seeing deeper structures in the world.

The second, *Navajo Math Circles* (2016), a one-hour film, a production by George Csicsery, MSRI and Vision Maker Media, documents a three-year project that has brought math circles to a number of schools on the Navajo reservation in the southwestern United States. The project and the film seek to show how the mathematics introduced at a Navajo math camp can be combined with cultural components from the indigenous community to enhance mathematics education and, more broadly, education as a whole for underserved populations.

However, mathematics-themed films in the public and private television environment face a variety of challenges. The expansion of social media platforms such as Facebook and Twitter favors production of shorter, high-impact video pieces, while long-form documentary delivered over television is becoming much less prominent. The web, however, does provide space for longer in-depth productions, such as the *Science Lives* biography series embarked upon by the Simons Foundation in 2010, which now hosts over 90 hours of oral histories with mathematicians telling their own stories.

5 Samples from the international landscape

The BIRS workshop showcased a rich and varied sampling of outreach initiatives currently being carried out in many countries. There are many commonalities, such as public lectures, mathematics enrichment sessions for school children, competitions, museum exhibits, movies, and theater performances. Without trying to be exhaustive, here are a few brief examples of national outreach activities presented by BIRS workshop attendees.

5.1 Australia

The *Australian Mathematical Sciences Institute* (AMSI) is a remarkable example of national outreach coordination. The Institute is engaged with the entire mathematics education pipeline: it develops materials for school grade mathematics, trains teachers, organizes career workshops for university students, places PhD students in industry internships, plans public events to popularize mathematics, and works directly with mathematicians. Most recently, AMSI has become involved in gender research and has started a successful gender-based outreach project called *Choose Maths*. The example of AMSI illustrates the advantage of packaging outreach initiatives under a single brand, and demonstrates the value of a good fundraising plan backed by research data.

5.2 Canada

Canada has a long and rich tradition in outreach. In order to maximize impact, it is structured by the three Canadian institutes, the *Centre de Recherches Mathématiques* (CRM), the *Fields Institute* and the *Pacific Institute for Mathematical Sciences* (PIMS). Other organizations include the *Canadian Mathematical Society* (CMS), the *Institut des Sciences Mathématiques* (ISM) and *Mitacs*. Activities include math camps in all provinces, competitions, two mathematical magazines for schools (*Pi in the Sky* and *Accromath*), theater shows, public lectures and lectures in schools, and First Nations mathematics education.

5.3 France

Mathematics outreach in France is in a large part coordinated by the *Animath* association. It is enjoying a growing level of activities and institutional recognition thanks to the *Cap Maths* component of the governmental *Investing for the Future* stimulus plan. High-level research mathematicians participate in the prestigious public lectures *Un texte, un mathématicien*, and many others go to schools around the country. The French *Centre National de la Recherche Scientifique* (CNRS) and the French *Institut National de Recherche en Informatique et en Automatique* (INRIA) sponsor the *Images des mathématiques* and *Interstices* websites highlighting current research. Specialized mathematics museums and centers in major cities (Lyon) as well as remote towns (Beaumont, Jeumont) have an increasing regional impact and will further develop with the future creation of a mathematics museum at the *Institut Henri Poincaré*. Theatrical plays and mathematics and art exhibitions are a significant aspect of mathematical outreach. Several competitions, team or individual (*Rallyes Mathématiques*, *Kangourou*, *Olympiads*, *Coupe Animath* and others) designed for all or for

highly talented and motivated students, are organized. The most motivated children can participate in mathematics camps during their vacations. Some of the aforementioned activities are specially geared towards disadvantaged youth living in the suburbs and rural areas, as well as girls.

5.4 Germany

In 2008, the *German Federal Ministry of Education* launched *The Year of Mathematics*, a very successful nation-wide communication initiative promoting mathematics outreach in Germany among the mathematical sciences, schools, and society at large. The *Deutsche Mathematiker-Vereinigung* (DMV) multiplied its outreach activities since the *Year of Mathematics* was developed, with the creation of a Media Office that provides mathematical topics, texts, and pictures to the media, and a Network Office that awards prizes to the best high school graduates in mathematics and honors volunteers engaged in mathematics activities (monthly, on its website). The *Year of Mathematics* boosted participation in traditional mathematics competitions, such as the mathematics *Kaenguru Competition*, the *Bundeswettbewerb Mathematik* and *Mathematik Olympiade*. In addition, the *German Mathematical Society* started a new online *Math Advent* competition that offers daily mathematics problems for students in grades 4-9 during the month of December, inspired by the *Matheon-Kalender*, a similar competition for college students organized yearly by the Research Center MATHEON. Germany's largest mathematics museum *Mathematikum* at *Gieβen*, Hessen, has a growing number of visitors each year, and many smaller museums and other science centers copied the successful format of hands-on exhibits.

5.5 United Kingdom

In the United Kingdom (UK), due to strong collaboration with the Department of Education, the *Higher Education Funding Council*, and other policy makers, outreach in the UK is highly recognized. In the recent *Research Excellence Framework*, a full 20% of a university accreditation score was based on the university's impact on industry and society. Although there is not one central institute in charge of every aspect of outreach, many of the activities are centrally coordinated and sharing of resources is common, thus facilitating the flourishing of outreach activities across the country. For example, more than 50 *Maths Masterclasses* for talented students are organized every Saturday by the Royal Institution. Held all across the country, these mathematics enrichment sessions exhibit an interesting mix of lectures and hands-on workshops. The *Maths Inspiration* program puts up theater shows all over England to attract teenagers to mathematics. The *UK Math Trust* organizes national competitions for young mathematics enthusiasts, while the *Mathematics Millennium Project*, based in Cambridge, promotes several initiatives to increase mathematical understanding, confidence and enjoyment, including visits to schools and internet-based resources such as problem listings and a mathematics magazine.

5.6 United States

The United States has a decentralized structure for mathematical outreach, with efforts led locally at schools and higher education institutes, by the major mathematical organizations such as the *American Mathematical Society* (AMS) and the *Mathematical Association of America* (MAA), and by major mathematics research institutes such as the *Mathematical Sciences Research Institute* (MSRI) and the *American Institute of Mathematics* (AIM). Efforts include competitions, exhibits, festivals, math days, Math Circles, math camps, films, and books. Of particular interest is the AMS competition *Who wants to be a mathematician?*. An increasing number of initiatives are aimed at under-served youth. Practitioners share resources informally; over the past decade, it has become common for major national mathematics conferences, such as the *Joint Math Meetings* and *MathFest*, to have special sessions related to outreach where participants present program information, resources, best practices, and lessons learned. Across higher education institutes, support for outreach activities varies widely. While many are active supporters, some still actively discourage graduate students and faculty from partaking.

6 Current examples of international collaboration

Levels of coordination within and across countries vary greatly from small local projects carried out once to large annual national and international projects. In this section, we discuss the successful *Mathematics of Planet Earth Year* in 2013 and the *Imaginary* platform for open and interactive mathematics.

6.1 Mathematics of Planet Earth

The *Mathematics of Planet Earth* (MPE) initiative illustrates a successful international outreach collaboration that models how cooperation can produce a synergistic effect. Using their own resources, a total of 140 partners around the world organized a plethora of scientific and outreach activities, many run collaboratively, centered on the common theme of *Mathematics of Planet Earth*. The MPE outreach activities included formal launches of the year, public lectures (including the International Simons public lecture series), special issues of magazines, museum exhibitions, events for teachers, and a Math Awareness Month related to sustainability. Countries and partners contributed resources and new educational material, and found creative ways to give a second life to older material; for example the *American Mathematical Society* Moments and the *Society of Industrial and Applied Mathematics* Nuggets issued special pages to illustrate highlights related to MPE. Finally, several blogs took place around the world, including two daily blogs, one in English, one in French, that were both later published as books.

Key to the success of the MPE program was the selection of an inspiring theme, which is endlessly creative and of interest to scientists, schools, journalists and public alike. The scope of the initiative allowed getting the patronage of UNESCO, and the endorsement of the *International Council of Science* (ICSU), the *International Mathematical Union* (IMU) and the *International Council of Industrial and Applied Mathematics* (ICIAM). Another important ingredient of success was the delocalized structure. The MPE coordinator, Christiane Rousseau, from the *Centre de Recherches Mathématiques* (CRM) in Montreal (Quebec, Canada), was assisted by several international committees, and the website migrated to a content management system, where partners could post their events themselves.

The MPE website was first hosted at CRM, until it moved at AIM to be transformed into a *Content Management System* website, where partners could post their events themselves. Currently, the MPE website is hosted at DIMACS, the *Center for Discrete Mathematics and Theoretical Computer Science* in Rutgers (New Jersey, USA).

6.2 Imaginary

Based at the Mathematics Institute at Oberwolfach (Black Forest, Germany), *Imaginary* is probably the most remarkable example of international platform for open and interactive mathematics. It features a variety of content that can be used at home, in schools, at exhibitions or in museums. The platform hosts picture galleries, hands-on exhibits (such as sculptures, puzzles, games and paper-crafts) and films on many mathematical topics for teachers, students, and the general public. Also included are a variety of visually attractive and highly interactive software modules (called "programs") to explore mathematics in a variety of contexts, from the melting of alpine glaciers to the vibration of a bridge in response to an earthquake. These open source exhibitions can be used to provide illustrations of mathematics in many different settings; they are cheap and readily accessible online, hence they provide a great avenue for international outreach collaboration. For example, the free software to create algebraic surfaces (available on the *Imaginary* website) was used to prepare many permanent and non-permanent exhibits around the world, triggering competitions for the nicest algebraic surfaces.

The *Imaginary* platform hosted the website for the international MPE competition, and is currently hosting the international Open Source MPE Exhibition.

7 Shared challenges and suggested solutions

One overriding theme expressed by many BIRS workshop participants was the concern that mathematics as a subject is very much misunderstood and that this leads to a dangerous lack of appreciation of the role mathematics plays in our society. Thus many of the workshop presentations expressed a common desire to

share mathematics with society, including communicating how it is used, cultural interactions, and the struggle to overcome the often-negative perception of mathematics among the public, media, and policy makers. This, combined with an apparent lack of recognition of the value of outreach in universities, make it hard to secure adequate funding for outreach activities. The relatively small number of professional mathematicians actively involved in outreach increases the burden on them to deliver, resulting in overload with respect to their other duties. Faculty involved in such activities need to be allotted more time to do outreach as part of their workload and should receive appropriate credit for it, as well as recognition of their work in outreach when it comes to promotion, hiring, and tenure.

A further difficulty lies in evaluating the effectiveness of outreach in its various guises. Due to the often short-term and informal nature of outreach initiatives, as well as the challenges in securing funding for and implementing long-term longitudinal studies, organizers of outreach activities struggle to measure their impact. A simple survey after the activity may reveal whether the initiative was a success, but the rarely measured long-term impacts remain difficult to evaluate or quantify. Hence, such long-term impact studies of outreach activities should be both undertaken and shared, and the results used in funding applications or in dealings with policy makers.

Perhaps the most important theme in the workshop was the growing need to address these challenges further by sharing resources and ideas across international boundaries, including those that separate prosperous economies from developing ones. It was also stressed that there is great value in creating online resources, blogs, and newsletters to support communication among those involved in all of these outreach activities.

The community should also work together to encourage more people to do outreach, with support for those involved in outreach (or wanting to become involved in outreach) including providing materials, training, and mentoring. Formal training on how to deal with the media would be valuable, especially for mathematicians leading wide outreach initiatives aimed at the general public, the media, or at policy makers.

One interesting aspect of the discussion was the recognition that students should be considered as partners in the realization of the outreach mission. Partially during their studies, and certainly after getting their degrees, it is natural for students to take an active part in the creation and dissemination of knowledge. Students can act as multipliers of the facultys outreach efforts. In addition, students are a great resource for recruiting new people into outreach, since they are naturally perceived as role models by younger audiences. In fact, students often represent more gender, social, and ethnic diversity than faculty do. Training students in outreach is beneficial for instilling confidence and for sharing knowledge to non-mathematicians. Globally, support from departments and individual professors is needed to help students become more involved with outreach, so that they can show and develop their passion for the subject.

8 Outcome of the meeting

Sharing a desire to continue efforts started at the workshop, participants decided to launch a new initiative - *Mathematics Outreach International* (MOI). MOI will support efforts to expand and enrich outreach activities worldwide, especially those aimed at developing countries and traditionally under-represented groups. MOI will get advice from an international advisory board made of prominent outreach leaders, launch a website containing resources and links to organizations, groups, and individuals coordinating national and international outreach activities, and contact the *International Mathematical Union* (IMU) to explore the possibility of becoming an IMU committee. In addition, MOI will organize workshops and conferences, and will propose them as satellite activities of international meetings of mathematical associations. MOI may also undertake other activities, such as the administration of an International Mathematics Outreach Blog, a newsletter, or soliciting guidance from its advisory board on how to encourage policy-makers to increase resources for mathematical outreach.

To ensure that things get started with a strong foundation, an initial MOI committee has been formed with members Martin Andler (France), Chris Budd (United Kingdom), Jean-Marie De Koninck (Canada), Janine McIntosh (Australia), and Diana White (United States). Eventually, it is hoped that a committee will be constituted on a more formal footing, actively involving the input and strong implication of international and national mathematical associations, international mathematical research institutes, and the mathematical community at large.

The BIRS *International Math Outreach Workshop* provided a unique opportunity for a diverse group of

international outreach experts to come together to share ideas, network, and make plans for more collective efforts in the future. The participants encourage the broader mathematical community to view mathematical outreach as an essential part of its contribution to society, and to consider getting involved and becoming more aware of ongoing efforts. They also solicit those in leadership positions to consider how mathematical outreach fits into their unit, as well as how they can promote mathematical outreach more broadly.