

This is the draft EPO Committee report for LRP2020

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## Introduction

The purpose of this report is to try and inform the LRP2020 committee about two aspects of astronomy Education and Public Outreach (EPO) in Canada. The first is the richness and reach of EPO in Canada. The second is the role of CASCA's EPO committee in this endeavour.

## PART 1 – Examples illustrating the Richness and Reach of EPO in Canada

### 1) EPO Activities across demographics.

Audience	Examples of Canadian Astronomy EPO
K-12 Students	School visits by Astronomers Summer camps University of Alberta USchool McGill Space Explorers Let's Talk Science
K-12 Teachers	Discover the Universe Alberta Science Network McGill Teacher Inquiry Institute
Girls and Underrepresented Youth	University of Alberta WISEST Dalhousie University Imhotep's Legacy Academy McGill Girls in Physics Day
Families with young children	Science Rendezvous Eureka! Festival
College and University students	McGill Physics Hackathon
Adults interested in science	Talks at RASC Centres Public Observing nights Planetarium shows on university campuses Western World Podcast York Universe Radio Show University of Toronto AstroTours

	AstroMcGill Public AstroNight
Adults not-so-interested-in-science	Sidewalk astronomy Astronomy on Tap Pint of Science Nerd Nite Large Public Events
Women and Underrepresented adults	SYSTEM Sounds University of Alberta WISEST
Indigenous peoples	Westar Lectures ii' taa'poh'to'p, Rothney Astrophysical Observatory Astronomy for Canadian Indigenous People, Mont-Mégantic Observatory Indigenous astronomy workshops
Science centres, Museums and Informal educators	Discover the Universe

2) Astronomy and astrophysics outreach activities compiled from the websites of Canadian universities.

Canadian University Astronomy EPO efforts			
University	Department or Institute	Name of Outreach group, Observatory or Planetarium	Activities
Brandon University		Brandon University Astronomical Observatory	Monthly public telescope observing nights
Dalhousie University	Physics and Atmospheric Science	Halifax Planetarium	Planetarium operated by RASC volunteers, school visits, week-long summer camps for youth
McGill University	McGill Space Institute	AstroMcGill	Monthly public lectures, Astronomy on tap (with iRex), and 24 h des sciences
McGill University	Physics	Physics Matters	Monthly public lectures, primary school visit program, teacher workshops, hackathon for high school-undergrad students, girls in physics visit day

McMaster University	Physics & Astronomy	Physics & Astronomy Outreach At McMaster, W.J. McCallion Planetarium	Planetarium shows, sidewalk astronomy, Online physics competition
McMaster University	Origins Institute		Public lecture series
Memorial University		Grenfell Campus Observatory	Occasional public observation sessions
Perimeter Institute			Public lecture series, arts and culture events, summer school program for senior high school students, games and videos for students, workshops and resources for teachers, research training for african students
Queen's University	Physics, Engineering Physics and Astronomy	The Queen's Observatory	Monthly public tours (short lecture + telescope observing), school tours
Queen's University	McDonald Institute		Visitor centre, Astronomy on tap, public lectures
Saint Mary's University	Astronomy & Physics	Burke-Gaffney Observatory	Weekly public telescope observing, private tours for school and community groups, Robotic telescope open to authorized members of the public
Simon Fraser University		Trottier Observatory	Bi-weekly public telescope observing, partners with RASC Vancouver Centre
Université de Moncton	Physics and Astronomy	L'observatoire du campus de Moncton	Monthly public telescope observing
Université de Montréal	Institute for research on exoplanets (iREx)		Astronomer visits to schools K-12, talks in schools (primary school to university), virtual classroom visits, "Astronomer for a Night" contest at OMM, Artist in Residence program, day-long internships for high school and CEGEP students. Public lectures, Astronomy on Tap (with AstroMcGill), 24 h des sciences, Festival Eurêka
University of Alberta	Physics	UAlberta Observatory	Weekly public observing (solar and evening). Hosts visits from schools, summer camps, and other groups. Public lectures and teacher workshops.
University of British Columbia	Physics & Astronomy	UBC Physics & Astronomy Outreach Program	Summer camps, science competitions, to teacher workshops and public lectures.

University of Calgary	Physics and Astronomy	Rothney Astrophysical Observatory	Monthly public Open House events with telescope observing. Curriculum targeted educational programming for all regional school boards.
University of Guelph	Physics	University of Guelph Observatory Telescope	Observatory available for group tours
University of Manitoba	Physics and Astronomy	Ewen Campus Observatory, Lockhart Planetarium	Monthly astronomy Open House, hosted jointly with RASC (telescope observing + planetarium shows)
University of Saskatchewan	Physics and Engineering Physics	University of Saskatchewan Observatory	Weekly public telescope observing, private tours for school and community groups
University of Toronto	Astronomy & Astrophysics, Dunlap Institute		Frequent Planetarium shows, monthly public lectures (organized by graduate students), sidewalk astronomy, Ask an Astronomer, Astronomy on Tap, all-ages events
University of Toronto	CITA		Classroom visits
University of Victoria	Physics and Astronomy	UVic Astronomy	Weekly public telescope observing, private tours for school and community groups, yearly public lecture, high school outreach with cosmic ray detectors, Café Scientifique and Historique, Ask us (questions about physics and astronomy)
University of Waterloo	Physics and Astronomy	Gustav Bakos Observatory	Monthly public tours (short lecture + telescope observing), private tours for school and community groups, Science open house, Online physics competition
University of Winnipeg	Physics		Let's Talk Science, School Tours and Visits,
Western University	Physics and Astronomy	Hume Cronyn Memorial Observatory	Weekly public telescope observing (May through August, otherwise monthly), program for school and community groups (lecture, hands-on activity, a tour of the telescope, and observing; in partnership with RASC), private observatory events, Science Rendezvous, Astronomy on Tap (with CPSX)
Western University	Centre for Planetary Science and Exploration		Primary school student workshops and activities, bi-weekly podcast, Science Literacy Week, Science Odyssey, 1-week camp for children several times

	(CPSX)		throughout the year, Astronomy on Tap (with department of Physics and Astro)
York University	Physics and Astronomy	Allan I. Carswell Astronomical Observatory	Weekly public telescope observing, radio show, private tours for school and community groups, online public observing, scale model of solar system on campus, evening for high school teachers

Note that this table does not include EPO efforts from amateur astronomy groups, professional observatories, and non-university affiliated planetariums, museums and science centres.

### 3) Number of Canadians inspired and engaged by CASCA members.

a) In 2011 the CASCA EPO Committee implemented an on-line reporting form to allow CASCA members to record their outreach activities. This form was somewhat successful at tracking outreach efforts in our community. These are the results of the first three years of data gathering (as analyzed by that EPO committee):

Activity	# of participants		
	2011	2012	2013
Astronomy course for non-science majors	5,609	5,500	205
Day-time observing	10	12,795	85
Night-time observing	5,945	4,720	3756
Public Exhibition	260	18,751	
Public talk	1,344	24,469	2181
School visit (4-8)	347	10,364	350
School visit (9-12)	25	9,625	185
School visit (K-3)	100	774	20
Other	187	21,189	4500
<b>Total unique people</b> (removing double-counts for events with more than one activity)	<b>13,757</b>	<b>46,069</b>	<b>12,045</b>

b) Interest among CASCA members to use the reporting form waned (probably beginning in 2013), and no data was available in subsequent years. To renew interest and encourage greater participation an easier to use form was implemented in 2016. Results for the 2018 year are shown below. There was a total of 72 data submissions. In total, over 71,000 members of the general public experienced some form of engaging astronomical learning due to the hard work of ~550 CASCA members and their helpers.

[https://wcm.ucalgary.ca/rao/outreach\\_reporting\\_form](https://wcm.ucalgary.ca/rao/outreach_reporting_form)

Affiliation	Event day	Month	Year	Visitors	Volunteers
McGill University - Dept. Physics			1/1/2018	1000	35
U of Calgary, RAO / RASC			1/1/2018	8525	50
University of Calgary			1/1/2018	400	10
Queen's University			1/1/2018	66	3
University of Waterloo			1/1/2018	1400	2
Bishop's University			1/1/2018	650	5
University of Alberta			1/1/2018	160	7
Thompson Rivers University			1/1/2018	225	1
Mount Allison University			1/1/2018	140	2
McMaster University			1/1/2018	88	10
McMaster University			1/1/2018	75	5
University of Victoria			1/1/2018	1050	9
NRC Herzberg			1/1/2018	4200	15
Trent University			1/1/2018	250	1
Institute for Research on Exoplanets			1/1/2018	400	3
Institute for Research on Exoplanets			1/1/2018	250	0
Institute for Research on Exoplanets			1/1/2018	510	5
University of Western Ontario			1/1/2018	150	3
<u>iREx - Université de Montréal</u>			1/1/2018	320	10
<u>iREx - Université de Montréal</u>			1/1/2018	600	5
<u>iREx - Université de Montréal</u>			1/1/2018	990	7
<u>iREx - Université de Montréal</u>			1/1/2018	3200	15
<u>iREx - Université de Montréal</u>			1/1/2018	5000	15
<u>Université de Montréal</u>			1/1/2018	1000	15
<u>Université de Montréal</u>			1/1/2018	1000	3
<u>Université de Montréal</u>			1/1/2018	700	10
CRAQ (U. de Montréal)			1/1/2018	3250	3
CRAQ (U. de Montréal)			1/1/2017	2000	3
UWindsor/ Windsor RASC			1/1/2018	2896	55
Collège de <u>Bois-de-Boulogne</u>			1/1/2018	10	1
Collège de <u>Bois-de-Boulogne</u>			1/1/2018	20	4
<u>Cosmodôme</u>			1/1/2018	8400	40
University of Alberta/Observatory			1/1/2018	1780	5

University of Alberta/Observatory	1/1/2018	2270	10
University of Alberta/Observatory	1/1/2018	170	3
Canada-France-Hawaii Telescope	1/1/2018	8000	40
Western University	1/1/2018	4783	40
University of Lethbridge	1/1/2018	550	5
		<b>66478</b>	
<u>iREx - Université de Montréal</u>	7/1/2018	2376	10
Physics Dept, University of Alberta	8/1/2018	25	1
Physics Dept., University of Alberta	7/1/2018	20	1
Physics Dept., University of Alberta	5/1/2018	15	1
		<b>2436</b>	
University of Toronto	2/6/2018	68	1
University of Toronto	2/7/2018	25	1
University of Toronto	3/7/2018	20	1
University of Toronto	4/12/2018	35	1
University of Toronto - Astronomy	4/13/2018	100	1
University of Toronto	4/18/2018	25	1
University of Toronto	4/20/2018	20	1
University of Toronto	4/26/2018	275	1
University of Toronto	5/8/2018	19	1
Thompson Rivers University	5/11/2018	21	1
Thompson Rivers University	3/27/2018	33	2
Thompson Rivers University	2/27/2018	35	2
Thompson Rivers University	1/1/2018	65	1
University of Toronto	5/12/2018	40	1
University of Toronto	5/14/2018	100	1
University of Toronto	5/25/2018	10	1
University of Toronto	6/12/2018	30	1
NRC HAA DAO	6/18/2018	18	1
University of Toronto	7/15/2018	35	1
University of Toronto	9/17/2018	2	1
University of Toronto	10/16/2018	55	1
Saint Mary's University	10/28/2018	45	2
University of Toronto	11/13/2018	50	1
University of Toronto	11/22/2018	28	1
University of Toronto	11/23/2018	20	1
FLL Robotics Coach	12/8/2018	32	3
Victoria DAO/HAA/NRC and RASC	11/16/2018	300	1
McMaster University	12/8/2018	150	1
McMaster University	8/3/2018	60	6
<u>iREx - Université de Montréal</u>	8/11/2018	500	20
<u>iREx - Université de Montréal</u>	11/8/2018	100	5
<u>iREx - Université de Montréal</u>	7/6/2018	4	2
<u>Université de Montréal</u>	11/2/2018	200	20
		<b>2520</b>	
<b>totals</b>		<b>71434</b>	<b>554</b>



There are two important things to note regarding this 2018 survey data: (1) It did NOT capture all of the year's activity, as the reporting form is used on a voluntary basis (we estimate it is likely that the actual number of Canadians inspired was probably 30-50% higher than 71,000), and (2) this number does NOT include people reached through traditional media and social media venues. Some CASCA members reported reaching thousands via their digital efforts, but these numbers were not included in the tally of 71,000.

#### 4) Examples of the growth of, and variety of, creative EPO activities in Canada in the last decade.

##### **a) Growing Interest in Science Outreach and Communication**

In the last decade, we've seen a growing interest in all aspects of science outreach and communication. This trend is noticeable in astronomy but also in many other scientific fields. Here are some examples highlighted by members of this committee:

- Serious discussions and considerations about EPO are more common amongst scientists.
- New training opportunities and events are being organized to help science communicators, such as the ComSciCon conference being held in Canada for the first time in 2019 and the new one-year Graduate Diploma in Science Communication offered by Science North and Laurentian University.
- Activity on social media shows a diverse and dynamic group of people interested in science communication, as highlighted by the hashtag #scicomm on Twitter.
- Public interest in astronomical discoveries and space missions, largely spread through social media, such as New Horizons, Rosetta, LIGO and the EHT black hole image.
- Large commitments to EPO, both in funding and thoughtful design, by large collaborations such as LSST.
- Popular citizen science platforms such as Zooniverse allow the general public to participate directly in the process of doing science

##### **b) Large Public Events for the Transit of Venus and the Partial Solar Eclipse**

While many interesting astronomical events happen every year in Canada (such as lunar eclipses, meteor showers and visible solar system planets), two major events of the last decade are worth mentioning at the national level. In 2012, the transit of Venus gathered national interest and viewing parties were organized across the country. To help with observations, the Dunlap Institute, helped with the Royal Astronomical Society of Canada (RASC) and the Fédération des astronomes amateurs du Québec (FAAQ), distributed over 43,000 eclipse glasses.

Of special note was the partial solar eclipse of Aug. 2017. Many groups distributed their own eclipse glasses and viewing events were held in countless locations, leading to record-breaking crowds. AstroMcGill distributed over 11,000 pairs of eclipse glasses and hosted a crowd of about 9,000 people on the McGill campus. In addition, about 30,000 people attended a solar eclipse event at the Planétarium Rio Tinto Alcan in Montreal. The EPO Outreach reporting form received many responses from CASCA members who capitalized on this event to inspire and engage the public. The total of all the data submitted was 43,000. Undoubtedly, this was the single largest astronomical public outreach event in the history of Canada.

##### **c) Qilak Award**

Following the International Year of Astronomy 2009, an award was created to recognize excellence in education and public outreach. Three awards are given each year, one for each organization involved in the creation of the award: CASCA, RASC and FAAQ. For CASCA, this award includes a prize lecture at the annual general meeting, highlighting the importance of EPO during the science meeting.

#### **d) EPO Positions in New Institutes**

Several new Canadian astronomy research institutions have been founded (or greatly expanded their operations) since 2010. Many of them - --perhaps all - include EPO as part of their mandate. These include the Dunlap Institute and the Centre for Planetary Sciences at the University of Toronto, the Centre for Planetary Science and Space Exploration at Western University, the McDonald Institute for astroparticle physics at Queen's University, the McGill Space Institute and the Institute for Research on Exoplanets in Montreal. This is a very positive sign, indicative of increasing awareness of the need for researchers to engage in EPO activities.

#### **e) Small Initiatives for Diverse Audiences**

A few smaller Canadian initiatives for diverse audiences have gathered the attention of the international funding campaign led by the IAU's Office of Astronomy for Development. The project SYSTEM Sounds received funding and international recognition for its original integration of science and art by turning science data into sound and music. This new approach is particularly interesting for people who are visually impaired.

In 2019, a program led by Ismael Moumen of Université Laval and also funded by the Office of Astronomy for Development is specifically targeting Indigenous youths and giving them the chance to meet astronomers and visit the Observatoire du Mont-Mégantic.

#### **f) Astronomy on Tap**

Astronomy on Tap (AoT) is a series of free public outreach events featuring engaging science presentations combined with music, games, and prizes in a fun, interactive atmosphere. AoT events feature one or more presentations given primarily by local professional scientists and graduate students, but also by visiting scientists, undergraduate students, educators, amateur astronomers, writers, artists, and other astronomy enthusiasts. Events are held at social venues like bars, breweries, coffee shops, and art galleries in order to bring science, the stories behind the research, and updates on the latest astronomy news directly to the public in a relaxed, informal atmosphere. Since the first New York City event in April 2013, over 600 AoT-affiliated events have been held in over 50 locations worldwide. In Canada, Astronomy on Tap events are organized by the Dunlap Institute (Toronto), AstroMcGill and iREx (Montreal), McDonald Institute (Kingston) and Western (London). Astronomy on Tap MTL / Astronomie en fût MTL was the first bilingual AOT series, launching in January 2017, alternating between English and French nights in monthly events.

#### **g) Involvement with larger Canadian Science Outreach Programs**

Canadian astronomers frequently contribute to larger, Canada-wide science outreach festivals and organizations. Many of these programs were founded or significantly expanded since 2010. In addition to "virtual classroom visits" such as; Skype a Scientist, Virtual Researcher on Call, DAO's CanYES, and Exploring by the Seat of Your Pants, they include:

- *Science Odyssey* - a NSERC-funded a two week-long, Canada-wide science festival, which replaced the National Science and Technology Week in 2016.
- *Science Rendezvous* - A day-long science festival, aimed at families with children. Part of Science Odyssey. It began as a joint program of the University of Toronto, Ryerson University, York University and the University of Ontario Institute of Technology in 2008. In 2019, there were 300 events across 30 cities.
- *24 Hours of Science / 24 heures de science* - A day-long, science festival across Quebec. Founded in 2006, in 2019 there were over 400 activities.
- *Science Literacy Week* - A week-long, Canada-wide celebration of science and outreach in Canada with events at libraries, universities, museums, funded by NSERC. Event began in 2014. In 2019 there were over 850 events in 200 cities across Canada.

- *Eureka! Festival / Festival Eurêka!* - Three day-long, science festival in Montreal, aimed at families with children, founded in 2007.
- *Pint of Science Canada* - A Canadian branch of an international science festival, where scientists discuss their research in bars, launched in 2013 in the UK and 2016 in Canada. Currently in 23 Canadian cities.
- *Nerd Nite* - Talks about “nerdy” topics, usually taking place in a bar. These talks cover a wide variety of topics, including science. Founded in 2003. Currently held in Toronto, Edmonton, Calgary, Vancouver and Victoria.
- *Let’s Talk Science* - Science outreach programs aimed at grades K-12, often delivered by volunteer university students, founded in 1991. Funded by PromoScience.

#### **h) Discover the Universe (DU)**

As a legacy of IYA2009, a national and bilingual training program in astronomy was founded and offered its first online workshop in 2011: Discover the Universe / À la découverte de l’univers. The founding partners were CASCA, RASC and the FAAQ. Over the years, the program has grown and gained credibility and popularity with different audiences: K-12 teachers, different science centres and museums, STEM outreach organizations and even international individuals and institutions. Teachers, in particular, are an important target group for Discover the Universe since astronomy is present in all provincial science curricula but many teachers feel uncomfortable teaching it. In 2016, the program was adopted by the Dunlap Institute at the University of Toronto while still being supported financially by CASCA and the Centre for Research in Astrophysics in Québec - CRAQ (contribution started in 2017). While this meant a reduced collaboration with the three original partners, Dunlap’s contribution saved the program and allowed it to grow. As of 2019, Discover the Universe is stronger than ever, with many partnerships being forged and many projects on the go. Discover the Universe is definitely a success story and a great heritage of IYA in Canada.

#### **i) CASCA Westar Lectureship (CWL)**

The Westar Lectureship was established in the early 2000s and ran for a few years with limited success. Due to lack of continued support by a dedicated person/team, the program eventually died out. CASCA decided to revive the program in the mid-2010 and the first lecture was given in 2017. A small committee was formed to run the program which includes recruiting lecturers, sending the call for proposals to communities, screening proposals, matching winning proposals with lecturers and supervising the organization of the visits/lectures. As of 2019, six lectures have been organized in various locations across Canada, including extremely remote locations such as Igloolik. The program is going well and is attracting many good proposals from communities to host lectures.

#### **j) EPO and Indigenous peoples**

There is a growing interest for Indigenous astronomy educational projects, especially in provincial school curriculum. Some first steps were taken in the last decade.

In 2017, and [Indigenous astronomy workshop](#) at the University of Toronto, brought together astronomers, educators and Indigenous scholars from around the Greater Toronto region to discuss methods for improving engagement with Indigenous communities and how to be more inclusive in delivering Indigenous knowledge in the classroom.

Western and McMaster Universities hosted a two-day Indigenous astronomy workshop in January 2019 led and facilitated by five Indigenous project members (from Western and McMaster universities, and from Six Nations of the Grand River) and supported by two non-Indigenous colleagues (also from Western and McMaster) with funding from the Government of Canada through an Indigenous Research Capacity and

Reconciliation Connection Grant. Key knowledge mobilization goals for the workshop included hosting local, national and international Indigenous astronomy experts and local Indigenous community members for the purposes of sharing Indigenous sky lore, forming new collaborations within and between nations, and facilitating and furthering efforts to increase Indigenous astronomy knowledge documentation and dissemination through university courses and outreach programs.

In 2019, the Mont-Mégantic Observatory received funding from the IAU Office of Astronomy for Development [for a pilot program](#): Astronomy for Canadian Indigenous People. This program involves sending astronomers to visit schools in the Indian reserve(s) to reach young Indigenous students and to bring a group of students to visit the Mont-Mégantic Observatory during the Popular Mont-Mégantic Astronomy Festival.

The Rothney Astrophysical Observatory has featured Indigenous focused programs for over ten years, and in 2016 a constellation guide project was completed on the RAO website. This guide blends traditional stories with contemporary astronomical constellation understanding. The RAO offers this information on its website as a resource for educators and students. RAO summer camp themes included traditional skills of wayfinding, time keeping and marking seasonal changes. The RAO delivers educational programs to indigenous students from the Tsuu T'ina, Stoney, and Siksika, Nations. The RAO has partnerships with the University of Calgary's Native Centre, Mount Royal University's Iniskim Centre, and the Boys and Girls Club Aboriginal Program. Creating relevant aboriginal content for all of its programs, and engaging Indigenous Students, is a priority for the RAO and is part of the University of Calgary's strategy ii' taa'poh'to'p.

While the CASCA Westar Lectures (CWL) are not specifically targeted at Indigenous communities, they do target astronomically 'underserved' communities, and so many remote aboriginal communities have been visited by CWL leaders. For example, Stanimir Metchev visited Ataguttaaluk Elementary School, in Igloodik, NU as a CWL Lecturer in April 2019. There "Prof. Bear" (*metchev* means *bear* in Bulgarian) lead activities with the majority Inuk students and teachers, learned about Inuk sky lore and helped a class of grade 7 students to build an igloo under the instruction of three village elders.

5) Work of the RASC and FAAQ (its massive! this section to be completed...)

## 6) Astronomy Education Research in Canada

An informal, bilingual survey about Astronomy Education Research (AER) done by CASCA members was conducted in early July, 2019 using Google Forms. An email invitation was sent to all CASCA members with a link to a 14-question form inquiring about demographics (name, affiliation, education, etc.) and AER-related activities (research topics, funding, graduate students involved, papers published, etc.). The form can be found here: <https://forms.gle/H7tBHtDFd1q9xuSa6>. This survey was conducted by Pierre Chastenay (UQAM) with the help of Michael Reid (Dunlap/UofT).

So far (July 16, 2019), only seven people completed the survey, and among these, only one respondent is truly involved in AER (funded research program, graduate students involved in AER and several peer-reviewed papers on this topic published). Other respondents are mostly involved in EPO, and there seems to be a certain confusion between AER and EPO in their minds, but all said that given the opportunity, they would be very interested in getting involved in AER, if only to improve their own Astro-101 courses or assess the effects of public involvement in citizen science research in astronomy.

Among respondents, four are University professors (one is retired), one is a College professor and two are graduate students (one MSc and one PhD). All are affiliated with either a College or University, and one respondent is also a volunteer at a local planetarium. In terms of funding for AER, only two respondents received grants for their research, one at the 1k\$-5k\$ per year level, the other at the 10k\$-50k\$ per year level, with funds coming from Federal and/or Provincial agencies, as well as institutional sources. It must be noted that one respondent might actually have listed funding for research in astronomy/astrophysics, and not AER. As mentioned earlier, only one respondent supervises graduate students doing AER and publishes peer-reviewed papers on the topic.

If the small number of respondents who completed the survey, and the small fraction of them that are truly involved in AER, are representative of the whole of CASCA, it thus appears that AER is not a topic of interest to the majority of CASCA members (while EPO is a whole different story, of course). But these results must be put into perspective, since there might be no more than 25 to 30 researchers worldwide that devote their research efforts solely to AER, so the situation in Canada is not as bleak as it seems.

There is certainly room for improvement, though. School curriculums in every Canadian province and Territories includes several astronomical topics at the Elementary and High school level (diurnal cycle, phases of the Moon, seasons, etc.), and teachers training in these subjects is of paramount importance if these topics are to be taught correctly (or at all). Any professional astronomer with access to university students preparing to be Elementary or High school teachers (pre-service teachers) could do AER through a Science Methods course (compulsory in most teachers training course). There is also a strong link between learning astronomy and developing spatial abilities, and spatial abilities are more and more considered core competencies in all STEM-related formations and jobs, as well as in the arts (i.e. sculpture, dance). All can benefit from well-developed spatial abilities, and learning astronomy can certainly help. Finally, The Discover the Universe/À la découverte de l'Univers program, a huge success for many years, could greatly benefit from a formal assessment of its impact on pre-service and in-service teachers, informal educators and the general public. There is a growing research trend studying MOOCs worldwide and an interested astronomer could indeed take advantage of DU/ADU graduates to do some very interesting and useful research.

### **Effectiveness of Canadian EPO activities**

A significant number of Canadians are reached by the voluntary EPO efforts of CASCA members (see sections 1-3 and 1-4(b) above), and a massive number are engaged as reflected in section 2 (above) as well as the national work of the RASC and the FAAQ (see section 5 above). But in order to more fully understand the effectiveness of Canadian EPO activities, either on the national or local level, we would have to collect more than a scattershot sampling of the number of people involved.

For example, we may want to know:

- Are we effectively using our resources?
- Are Canadians aware of current astronomical research or Canadian observatories?
- How many people are we reaching with our EPO efforts?
- Are we reaching our intended audiences?
- Are we meeting the needs of our local communities?
- Are we reaching new audiences, or simply holding events for “regulars”?
- What are the demographics of people who we reach with our EPO activities? What languages do they speak? Are they similar to the local population?
- Are we reaching women, girls and other underrepresented groups?
- How much prior knowledge do our audiences have?
- Are we successfully communicating scientific ideas to non-specialist audiences?

- Do our outreach efforts do anything other than giving our volunteers warm fuzzy feelings?
- What is the retention level of our reached audiences?

Answering these questions, especially on the national level, requires data that is almost impossible to collect given the current status of EPO in Canada. Given the small numbers of AER professionals in Canada (see previous section), it is unsurprising that this has not been done. Some programs may collect a limited amount of data, for example on audience demographics or social media followers. However most since efforts rely almost entirely on volunteers, have short institutional memory and very small budgets, almost few make an effort to evaluate their own effectiveness. Since there is no national coordination or funding for program evaluation, this situation is unlikely to change in the near future.

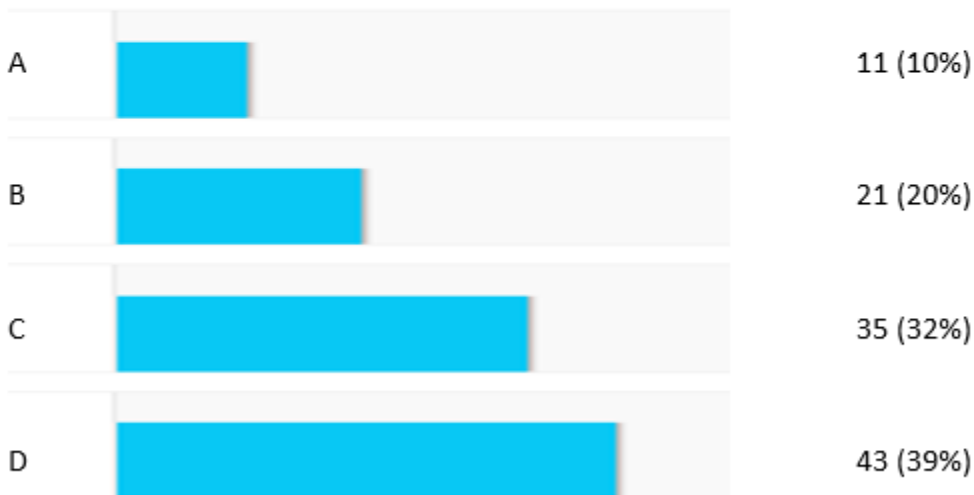
## PART 2 – The Role of CASCA’s EPO committee in EPO in Canada

### 1) CASCA members are EPO enthusiasts, True or False?

A recent inward-facing analysis of the ‘spirit of CASCA EPO’ was recently conducted using two broad tools: An anonymous two-question poll conducted at the morning LRP session at the recent AGM in Montreal, and, a simple statistical review conducted to gauge the amount of EPO activity CASCA members organize and engage in, in a typical year. An electronic polling tool was used (TopHat), and all responses were completely anonymous. These are the poll questions, and the responses of CASCA members:

1) Over a typical calendar year, the number of times I actively engage in teaching/inspiring the general public is;

- a) (0)
- b) (1-2)
- c) (3-4)
- d) (5+)

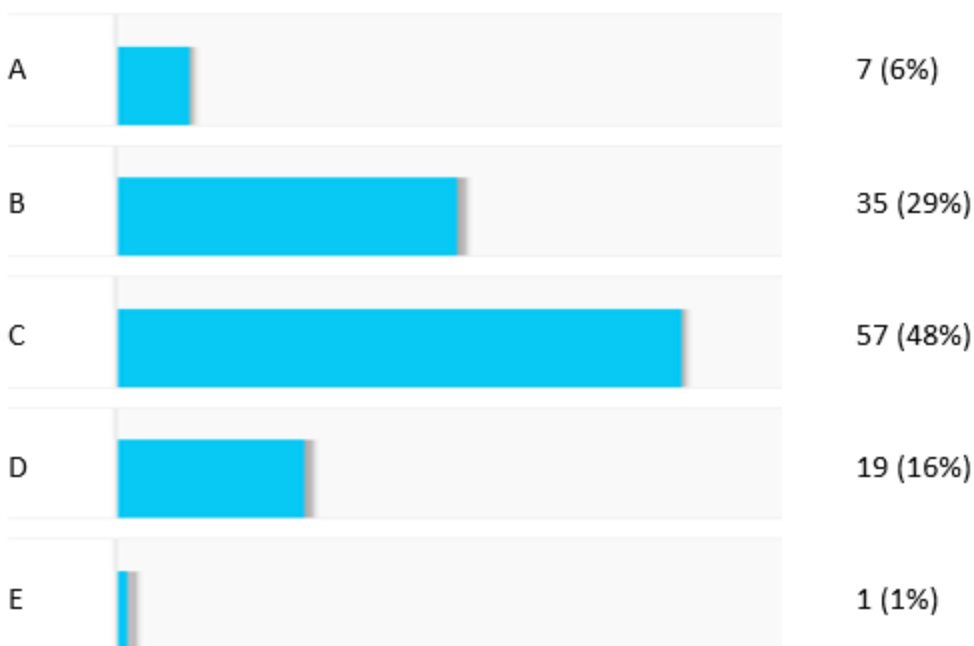


Total responses = 110

2) Your Society does many things for its members (this page from the CASCA website was reviewed and discussed for several minutes: [https://casca.ca/?page\\_id=31](https://casca.ca/?page_id=31) ).

Relative to all the things on that list, in your view, where does CASCA’s EPO effort rank in importance;

- a) Near the top
- b) Pretty high
- c) In the middle
- d) Pretty low
- e) Near the bottom



Total responses = 119

So what does this tell us about CASCA EPO?

Only 10% of responders indicated that they do not participate in EPO activities in a typical year. However, 50% get their hands dirty between 1 and 4 times in a typical year, and 40% do so 5 times or more (110 responders is ~25% of the CASCA membership, so this sample size very likely reflects the opinion of the Society overall). So CASCA members believe that EPO is sufficiently important that they themselves instigate and engage in it.

This conclusion is heavily supported by the numerical data that CASCA members reported for 2018 (see section 1-3(b) above). Nearly 550 CASCA members and their collaborators engaged, inspired, and educated, over 71,000 Canadians. There was no ‘super attraction’ in 2018, like the solar eclipse of 2017 (where 43,000



Canadians engaged by CASCA members with this one astronomical event), so this 2018 data reflects the generic day-to-day effort of CASCA members over a typical year.

The second poll question was an attempt to gauge the overall sentiment of the CASCA membership about the importance of the EPO effort of their Society, relative to all of the various efforts and activities their Society advocates for. Very close to 50% of responders put EPO importance in the middle of the pack. The telling result is that outside of those 50%, twice as many responders put EPO importance in the high range than those that put EPO importance in the low range.

So what are the take-home messages from this inward-facing analysis? First, it is not just speculation -> the majority of CASCA members do believe that astronomical Education and Outreach for the general Public is important, to the point that many roll up their sleeves and do the hard work, with amazing success. Second, the CASCA membership, by virtue of its EPO enthusiasm, surely desires its EPO committee to be effective and relevant. Interestingly, the EPO work in 2018 (or any typical year) is essentially all 'grass-roots' effort. Aside from offering a little encouragement, CASCA's EPO committee did little and CASCA volunteer members did tons.

## 2) EPO recommendations from LRP2010 and MTR2015

In the 2010 Long-Range-Plan report, three recommendations were made regarding EPO. This is a summary of those three, and the eventual outcome:

LRP2010 Recommendation	Outcome
<p><b>Recommendation 36</b> Graduate programs should strongly consider adding some element of outreach, either training or project requirements, to their programs</p>	<p>Most universities in Canada with graduate programs in physics and astronomy engage in some form of public outreach. Often, these programs are staffed by graduate students who receive teaching assistantships or who volunteer their time.</p> <p>However, formal training, projects or official academic recognition of EPO efforts are rare. McGill Physics recently started offering a co-curricular record (CCR) on student transcripts to everyone who volunteers at least 10 hours per year on outreach activities.</p>

<p><b>Recommendation 37</b> The LRPP recommends that the “AstronomyCanada.ca” website be co-developed with a brand awareness campaign led by the professional community.</p>	<p>No website was created. There were long discussions within the EPO committee and since no one had the time/money to lead this, the project was abandoned.</p> <p>The RASC seemed to have an interest in the project but nothing concrete happened.</p> <p>This project dates back to first LRP 2000-2010. There was a PromoScience funding proposal about it in 2005 but it was not accepted.</p>
<p><b>Recommendation 38</b> The LRPP reiterates the value of investing a 1.5% fraction of government funding of new large-scale projects into outreach</p>	<p>This recommendation was never pursued by the CASCA Board. However, local institutes (Dunlap, iREx, CPSX, McDonald) have created local EPO positions.</p> <p>This recommendation was made by the first LRPP 2000. Also, not pursued by the CASCA Board.</p>

As we can see, the results are not positive based on these recommendations. None of them achieved successes.

In the Mid-Term-Review Report, published in 2016, three different recommendations were made:

<b>MDR 2016 Recommendation</b>	<b>Outcome</b>
<p>CASCA draft a mission statement on its EPO activities and goals.</p>	<p>This was never done and it should be a priority for the EPO committee. It will be the subject of a separate white paper.</p>

<p>Social media should be considered a key component of organizational outreach strategies. Appropriate resources, specifically funds, talent, energy, and time, should be allocated</p>	<p>Social media wasn't mentioned in LRP2010 but was added in 2015. The EPO committee had discussions on the subject and asked the Board for guidance regarding CASCA's Twitter account.</p> <p>As defined by the CASCA board, the goals of our social media outreach are:</p> <ol style="list-style-type: none"> <li>1) Promote successes of Canadian professional astronomers and increase the awareness of Canadian astronomy (and by definition make agencies aware of their role in this success)</li> <li>2) Promote the moral and ethical values of the Society</li> <li>3) Build bridges to other science organizations in Canada</li> <li>4) Preserve the reputation of the Society</li> </ol> <p>Due to lack of resources, it was decided to keep the status quo, which is that this account is run by volunteers Kelly Lepo and Daniel Majaess. Kelly Lepo also created a Facebook page for CASCA, which is infrequently updated.</p> <p>The lack of resources also means that only a limited amount of media creation and curation is possible. For example, CASCA does not have an Instagram account, since posting new Canadian astronomy-related images frequently is beyond the scope of what can be done by volunteers. The AstroCanada CASCA twitter account mostly retweets content from Canadian astronomers and institutions.</p>
<p>NSERC commit to expanding the PromoScience program budget, while NRC return to funding astronomy-related outreach at levels similar to the 2000-10 decade.</p>	<p>NSERC PromoScience was expanded and the budget available for science promotion programs has grown. However, this doesn't guarantee anything for astronomy outreach. Furthermore, PromoScience only covers about 30% of a project so it isn't a solution in itself: other sources of funding are required.</p> <p>In addition, PromoScience does not support programs aimed at pre-school aged children, general postsecondary students, adults or the general public. It also does not support new or pilot programs without strong prior evidence for the impact of the program, and local programs that are not specifically targeted at traditionally under-represented groups.</p>

	<p>These gaps in funding eligibility cover many areas of growth in astronomy EPO in the last decade (for example: undergraduate summer programmes, Astronomy on Tap, large public events, lecture series aimed at adults).</p>
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Again, we can see the results of these recommendations are not great. Consequently, the EPO committee has been unable to grow, in any substantive way, new and meaningful EPO projects.

## Conclusions

Part 1 of this report was only a spattering of all the astronomy EPO that occurs in Canada annually. However, even this snapshot reveals that the effort is overall very healthy, and those with their 'boots on the ground' to offer EPO experiences work hard and do so with pride and satisfaction. It is also very important to mention that, aside from

Part 2 focused more specifically on CASCA, and what its committee does for EPO in Canada. Recent analysis indicates that many CASCA members freely volunteer their time and energy to instigate and provide EPO, using whatever scant budget they can muster from their realm (or with no budget at all). Also, CASCA members are generally enthusiastic about EPO, by which this committee is very encouraged.

But what 'boots on the ground' EPO does this committee do? Among the long list of endeavors presented in Part 1, there are just two activities that the CASCA EPO committee owns; the CASCA Westar Lectures (CWL) and Discover the Universe (DU). We would offer that this committee needs to be doing more, specifically around activities that are national in scale. The "1.5% proposal" described in the LRP2010 recommendations (which originated in the LRP2000 report) would be ample to operate ambitious national-scale projects.

As a last note, pertaining to this, we offer in the appendix a portion of *NSERC 2020 A STRATEGIC PLAN*.

## APPENDIX

From NSERC 2020 A STRATEGIC PLAN

[http://www.nserc-crsng.gc.ca/NSERC-CRSNG/NSERC2020-CRSNG2020/index\\_eng.asp](http://www.nserc-crsng.gc.ca/NSERC-CRSNG/NSERC2020-CRSNG2020/index_eng.asp)

### 1) FOSTER A SCIENCE AND ENGINEERING CULTURE IN CANADA

Popular accounts of scientific breakthroughs are often punctuated by a clear, bright shout: eureka! Without a doubt, discoveries can sometimes seem like purely spontaneous and serendipitous events. The underlying reality, however, suggests that for every breakthrough there is a highly skilled, analytical, and observant scientist who recognizes when a fluke or random event might just signal something more meaningful.

Promoting science and understanding how scientific inquiry works are critical to the creation of a vibrant science culture in Canada. To ensure that Canadians continue to create a highly skilled workforce, to generate new knowledge globally, and to accelerate the development of knowledge-based industries, we must cultivate a science culture in this country. Efforts to raise awareness and interest in science and engineering need to focus on young people and give them the foundation for the knowledge-based jobs of the future. Likewise, curious and engaged Canadians, including policy and decision makers, can benefit from greater understanding of the societal and economic role of science and technology in the world.

#### Goal

Make science and engineering mainstream. Increase interest, awareness, and appreciation of science as a way of experiencing, understanding, and enriching the world.

#### Strategy

Take a national leadership role and provide a focal point for science promotion efforts in Canada.

#### Supporting Actions

NSERC will explore mechanisms and approaches to:

- Engage a wider range of partners to deliver youth outreach and public engagement activities.
- Mobilize and empower our research community to demonstrate the value and impact of its work to a broad audience.
- Recognize and reward science promotion, outreach, and mentoring activities during the assessment of research grant and scholarship/fellowship applications.
- Raise awareness of science and engineering and combat negative stereotypes, particularly among young people and underrepresented groups.
- Undertake communications activities to demystify science and engineering aimed at the general public and at decision makers.

#### Outcome

The creation of a robust culture in Canada that values science and engineering.