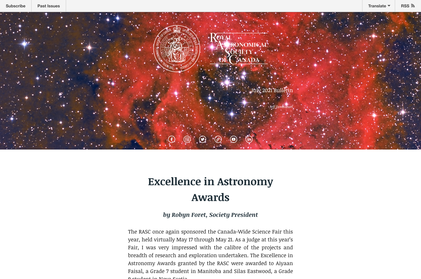

Excellence in Astronomy Awards

by Robyn Foret, Society President

The RASC once again sponsored the Canada-Wide Science Fair this year, held virtually May 17 through May 21. As a judge at this year's Fair, I was very impressed with the calibre of the projects and breadth of research and exploration undertaken. The Excellence in Astronomy Awards granted by the RASC were awarded to Alyaan Faisal, a Grade 7 student in Manitoba and Silas Eastwood, a Grade 9 student in Nova Scotia.

Alyaan's project **Mex Satellies** (My Satellite) won a Silver Medal in the Fair and the junior-level Excellence in Astronomy Award. MEA SATELLIES (My Satellite) is a desktop app for the tracking of satellite orbits based on Newton's Laws of Motion, the Law of Gravitation, and Kepler's laws of planetary motion. The app can track the orbit of a satellite around the Earth (or another planet) based on the satellite's initial position and velocity vectors. The app uses numerical methods to advance the satellite along its orbital path, which can be of circular, elliptical, parabolic, or hyperbolic in shape. The app can determine common orbital parameters (shape, period, inclination, apoapsis, periapsis), simulate atmospheric drag, and produce ground track on a 2D map. Ground track is the projection of the orbital path to the surface of the Earth, which is rotating about its axis. Mex Satellies has been created using JavaFX. Alyaan's project board states: "I needed to combine elements of science, math, and coding to build the project. I used Newton's Second Law of Motion, and the Law of Gravitation to estimate the acceleration of a satellite and the impact of drag on its velocity (Kuhn, 1996, Fleisch & Kregenow, 2003). I followed an algorithm from Meiers (2016) to update the satellite's position in Earth-Centered-Inertial (ECI) coordinates. Next, I calculated orbital parameters from the initial state vector (Schwarz, 2017).

Finally, I followed Beasley & Sikaneta (2005) and Ali (2014) to transform ECI coordinates to Earth-Centered-Earth-Fixed (ECEF) coordinates and find out the latitudes and longitudes for ground tracking. This step is needed due to the rotation of the prime meridian relative to the space-fixed ECI coordinate system. I also applied corrections for the ellipsoidal shape of the Earth. To better understand the math, I had to learn more about conic sections and basic trigonometry from Abramson (2017) and Math is Fun (2020). They helped me to understand the concepts such as eccentricity, period, apoapsis, periapsis, and inclination. I learned how to code in Java and use its graphics libraries from Lowe (2017, 2015).

My app has six core components: graphical user interface (GUI), input validator (the satellite must be located above the ground surface), calculator for updating position and velocity vectors, 3D orbital path simulator, latitude and longitude calculator, and ground-tracking simulator. The app was developed in small blocks. Each block was tested separately to get rid of any bugs and fine tune the visual elements. The estimated orbital parameter values were compared with the same from published sources. In all cases but one, the estimated results matched the original parameters exactly; only the estimated value of a (semi-major axis) differed from the original value by a negligible margin (0.0000 percent)." Alyaan is now a Youth Member of the Winnipeg Centre and the recipient of a Celestron StarSense Explorer DX102AZ telescope.

Silas' project, **Revolution Evolution: The Design Evolution of a Space-Qualified Reaction Wheel** won a Gold Medal at the Fair and the Intermediate-level Excellence in Astronomy Award. At the heart of any satellite is the attitude determination and control System (ADCS) It gives the satellite the ability to stabilize itself as well as control its orientation. At the heart of most satellite active control systems are reaction wheels. Reaction wheels, or momentum wheels, are used to generate angular momentum. This stored momentum is what gives the ADCS its ability. This report describes the design evolution and creation of a space qualified reaction wheel suitable for a small class of satellite called a CubeSat.

Silas' project board states: "Last year's science fair project, SMARTEN, where I created a simulated microgravity and reduced friction testbed for small satellites called CubeSats, led to me being invited to join Dalhousie Space Systems Lab's CubeSat project (Low earth Orbit Reconnaissance Imaging Satellite, LORIS). That work was the motivation for my science fair project this year. I was specifically tasked with designing a reaction wheel, which is a component that gives the CubeSat the ability to stabilize and orient itself. I got interested in reaction wheels because I needed to build one for SMARTEN. While primitive, that one was a good starting point for this year's project.

A reaction wheel is typically made up of a disk that spins, called a flywheel, an electric motor that powers it, bearings that provide a low friction surface that the flywheel spins on, electronics to control the speed, and an enclosure to protect components and provide mounting surfaces. As compared to other control system options, reaction wheels respond rapidly and accurately, but they are very expensive. The reaction wheel's angular momentum provides a rotational force on the rest of the satellite, causing it to change its orientation and angular speed.

The main goal is to provide a versatile alternative to commercial reaction wheels so that organizations with limited budgets can expand the types and number of missions they can pursue." Silas is now a Youth Member of the Halifax Centre and the recipient of a SkyWatcher 8" Dobsonian telescope. He is also a named contributor of the LORIS team at Dalhousie University. The future of scientific exploration and research in Canada is very promising.

Telescope for Isaac

The RASC and Sky-Watcher come together to grant a sick child his wish.

"He was a healthy boy," Irma Mendez said of her son Isaac. However, the events of December 7, 2020, changed the lives of the Mendez family forever. After his third Emergency hospital visit, doctors decided to send Isaac for blood work. Unfortunately, the tests revealed that Isaac Ladino, age 11, had Acute Lymphoblastic Leukemia. The horror of Isaac's diagnosis shook his family, including three other siblings, to the core. "Isaac was a normal kid," Irma continued. "He likes building structures, playing soccer and video games." Another one of Isaac's interests was the stars and all things related to astronomy. "He has always been into the planets, the solar system and science," she shared.

Acute lymphoblastic leukaemia (ALL) is a type of blood cancer that starts in white blood cells in the bone marrow. It develops from immature lymphocytes, a kind of white blood cell that's key to the immune system. ALL is also known as acute lymphocytic leukemia or acute lymphoid leukemia. "Acute" means it progresses quickly. It's a rare type of leukemia, or blood cancer, in adults but most common in children. Acute lymphoblastic leukemia invades the blood and can spread to other organs, such as the liver, spleen, and lymph nodes. However, it rarely creates tumors like other types of cancers.

Isaac's doctors immediately put him on a very aggressive treatment plan. As a result, he and his family had to leave their home in Edmonton and move to the neighbouring Province of Saskatchewan to be closer to family support. Isaac's treatment leaves him feeling weak and unwell for several days.

Throughout this horror, Isaac has managed to continue his passion for science and all things related to astronomy. In mid-March of 2021, Isaac's school teacher, Krissa Donahue from Steinhauer School in Edmonton, contacted The Royal Astronomical Society of Canada. She said, "I walked alongside his family when they learned of his diagnosis and was inspired by Isaac's strength and appreciation for life." Ms. Donahue shared Isaac's wish of owning his very own telescope and his hopes of exploring space and pursuing his dream of serving our world as an astronaut. She asked the Royal Astronomical Society of Canada (RASC) to consider assisting in providing a telescope or space-related resources for Isaac.

The RASC contacted friend Jeff Simon, Director at Sky-Watcher, who immediately agreed to provide a telescope for Isaac. And just like that, "Operation Isaac's Telescope" was underway. A Sky-Watcher Evolfar 80ED telescope, a free RASC membership and an RASC membership package were sent to Isaac's home.

Anticipation and excitement filled the room as Isaac's mother called him downstairs for the big reveal. Tired from the side effects of his treatment, Isaac came down the stairs. To his surprise, there was a large box awaiting him. Isaac opened the box, his eyes lit up, and he gasped in shock. Then, in disbelief, he looked at the unassembled telescope and, at that moment, he saw hope and endless possibilities for his future.

Irma thanked Phil Groff, Executive Director of The RASC, and Jeff Simon, Director of Sky-Watcher, for their generosity. She stated, "The RASC and Sky-Watcher have brought Isaac so much joy during this challenging time of countless blood tests, procedures and chemotherapy treatments." Irma also thanked his caring teachers, Krissa Donahue and Jennifer Webb. They went over, above and beyond, to help provide the Mendes family with love, support and comfort during a very stressful and terrifying time.

The Royal Astronomical Society of Canada is proud to have Isaac Ladino as a member. If you would like to help Isaac with his medical expenses, please click below:

Click here to help with Isaac's medical expenses

Observing Committee Digest

There's been a change of the guard in the Observing Committee. Blair Stunder was chair from 2019 February to 2020 May. He stepped down and Blake Nancarrow is serving as Interim Chair. We thank Blair for his hard work and guidance.

As you may know, 2020 was a very good year for observing certificates awarded, one of the highest in over a dozen years, with 39. As wonderful as that is, 2021 might be a record-breaker! At the time of writing, we're at 35. So, keep those RASC observing applications coming in!

Since mid-March...

Explore the Universe: **John Crawford** of Toronto; **Christopher Purse** of Victoria; **Colin Urbaniak**, non-member from London; **Matteo Statti**, youth member of Mississauga; **Ronald Gwinnliter**, non-member from Kingston; **Patricia Sellis**, new member from Prince George; **Dave Anderson** of Ottawa

Explore the Moon—Binocular: **Susan Hart** of St. John's; **Abby Choi** of Vancouver

Explore the Moon—Telescope: **Ian Bain** of Toronto; **David Hoskin** of Halifax; **John Read** of Halifax; **John Crawford** of Toronto; **Richard Weatherston** of Toronto; **Judy Black** of Halifax; **Jill Sinkwich** of Victoria; **Liz Greenough** of Halifax

Messier Catalogue: **Frank Dempsey** of Toronto

Isabel Williamson Lunar Observing Program: **Charles Ennis** of Sunshine Coast

Deep Sky Gems: **Emile Cormier Jr.** of New Brunswick

Congratulations, all!

The newest RASC program, Double Star certificate program, is being pursued by at least a dozen members, that we know of. Please tell us if you're working on it. We'd love to hear from you.

The Moon At Noon online course webinar was delivered on Thursday and concluded in June. We thank the hosts **Samantha Jewett**, **Jenna Hinds**, and **John Read** for promoting the Moon observing programs, and showing by doing.

Let us know if you have any questions or there's anything unclear. We're here to help.

Keep on observing!
submitted by Blake
observing@rasc.ca

Creation Station Extension

DEADLINE EXTENDED TO JULY 31!
The RASC invites kids ages 5-12 to share their short stories, drawings, poems and comics about Astronomy and Space. Visit rasc.ca/creationstation for more information and to submit your creation!