# TELUS WORLD of SCIENCE - EDMONTON CSA EDUCATOR'S GUIDE





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### 1. Introduction

### Canadian Science & Engineering: A Path Back to the Moon

It seems like ancient history to many students today, but a little over 50 years ago we humans took our first steps on that dusty surface of the Earth's closest neighbor, the Moon. From 1968 to 1972, there were a total of nine human missions to the Moon, with six successful landings on the Moon. In total, only 12 individuals ever walked on the Moon. The most famous moonwalker being Neil Armstrong, who on July 20, 1969, was the first human to place a footprint and then take a walk on the surface of the Moon, saying the words that will forever live in the history books: "That's one small step for "a" man; one giant leap for mankind". Now, over 50-years later, humans are finally planning on returning to the Moon. This time hopefully for good, with greater ambitions, and with new partners to take the journey with.

The first missions to the Moon were called Apollo after the Greek god of light, music and the Sun. The next chapter of human exploration of the Moon is called Artemis, named after the god of the Moon and the twin (sister) of Apollo. This next step in lunar exploration has already begun with the testing of the Artemis rocket, called the Space Launch System, or SLS, and the Orion crew capsule. Astronauts have already been selected and have been training specifically for these up-and-coming lunar missions. This time however, it will not just be male NASA astronauts from the USA that will be making the trip. It will be a partnership of various countries and organizations like the European Space Agency (ESA), the Japan Aerospace Exploration Agency and the Canadian Space Agency (CSA) that will also be sending their astronauts, both male and female, to the Moon! Yes, there will be Canadians going to the Moon for the very first time and maybe even walking on the Moon. This is an exciting time!

Currently, the live Zeidler Dome planetarium guide will host a presentation before the feature show to explore the Moon and how Canadian scientists, engineers and astronauts have and will be involved in lunar exploration.

In addition to a Zeidler Dome show, other activities are available for your students at The TELUS World of Science – Edmonton which will engage them in the science and engineering principles needed for these next steps back to the Moon. Check out the new "Lunar Landscapes" Robotics programs and our S.P.A.C.E. Gallery as part of your visit.



# 2. What is the Canadian Space Agency?

The Canadian Space Agency (CSA) is Canada's national space agency which oversees a wide variety of space exploration and spaceflight-related programs, including the Canadian Astronaut Corps, satellites such as the RADARSAT constellation, and robotic technologies such as the Canadarm2. Officially formed on March 1, 1989, the CSA builds upon the legacy of Canadian innovation in space exploration.

Before the formation of the CSA, Canadians contributed to spaceflight through individual innovation, international collaboration, and government agencies, such as the Canadian Defence Research Telecommunications Establishment (DRTE).

In the late 1950s, influential Canadian space researcher John H. Chapman led the development of sounding rockets and satellite technology that would culminate in the launch of Alouette I, Canada's first satellite. Launching on a NASA Thor-Agena-B rocket on September 29, 1962, Alouette I made Canada the third country to build and operate a satellite.

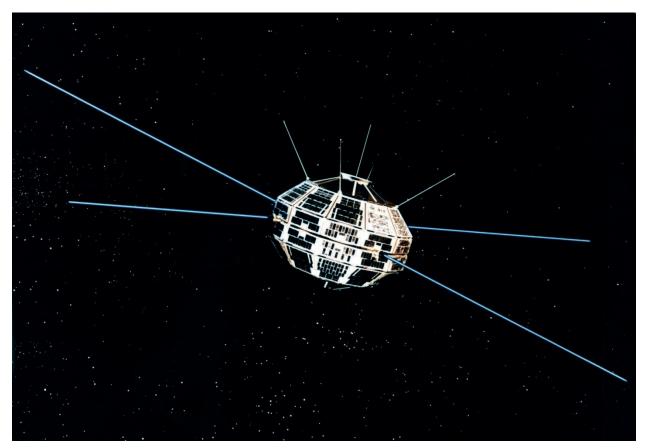


Figure 1 Alouette I, Canada's first satellite. (Credit: Canadian Space Agency)

Throughout the 1960s, numerous Canadian engineers left jobless by the cancellation of the Avro Arrow program joined NASA during the development of the Mercury, Gemini, and Apollo programs. Among the engineers were Jim Chamberlin and Owen Maynard, who were highly influential in NASA's Apollo lunar program. Jim Chamberlin was a notable advocate for the Lunar Orbit Rendezvous technique used during the Apollo lunar landing. Owen Maynard is often cited as the individual most responsible for the design of the Apollo Lunar Module.





Figure 2 Jim Chamberlin and Owen Maynard commemorated with a Canada Post stamp. (Credit: Canada Post)

During the 1970s, Canada firmly established its role as a leader in space robotics by developing the Shuttle Remote Manipulator System for NASA's Space Shuttle. More widely known as the Canadarm, it paved the way for future Canadian robotic systems, including the Canadarm2 and Dextre onboard the International Space Station and the upcoming Canadarm3 on the Lunar Gateway.

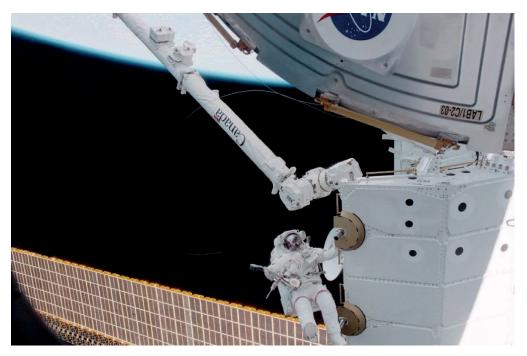


Figure 3 Canadian astronaut Chris Hadfield alongside the Canadarm2 during mission STS-100. (Credit: NASA)



Canada's participation in the Space Shuttle program also includes the launch of Canada's first astronaut, Marc Garneau, on STS-41-G. His mission to space from October 6-13, 1984, would be the first of many for the Canadian Astronaut Corp. Later Canadian astronauts to fly on the Space Shuttle would include, Roberta Bondar, the first Canadian woman in space, and Chris Hadfield, who has visited both Mir and the International Space Station, among others.



Figure 4 Roberta Bondar (left) working in the International Microgravity Laboratory during STS-42.

In 1979, a decade before the formation of Canada's space agency, Canada became a cooperating state in the European Space Agency. This cooperation has been extended beyond its initial five-year agreement to become a lasting partnership with Canada remaining the only non-European nation to be a part of the European Space Agency.



Figure 5 The emblem seal of the European Space Agency featuring the Canadian flag.



Canada's signing as a full partner in the International Space Station on March 18, 1986, would be a significant moment for strengthening connections between Canada and other space-faring nations, including the United States of America and the then Soviet Union.

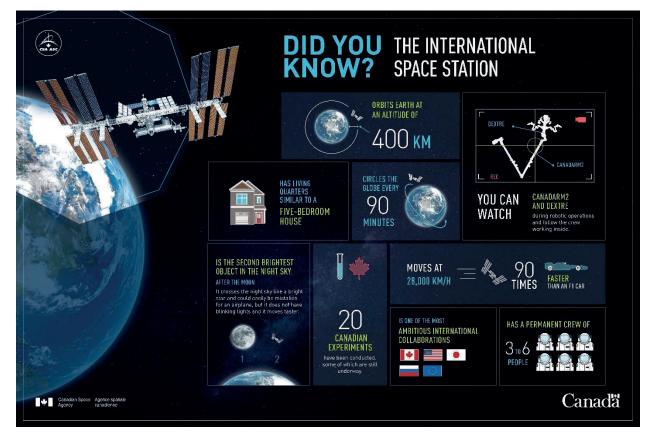


Figure 6 Quick facts on the International Space Station (Credit: Canadian Space Agency)

With the formation of the Canadian Space Agency in 1989 and the passing of the Canadian Space Agency act in 1990, Canada finally had a formal government organization to manage space exploration, space utilization, and space science and technology.



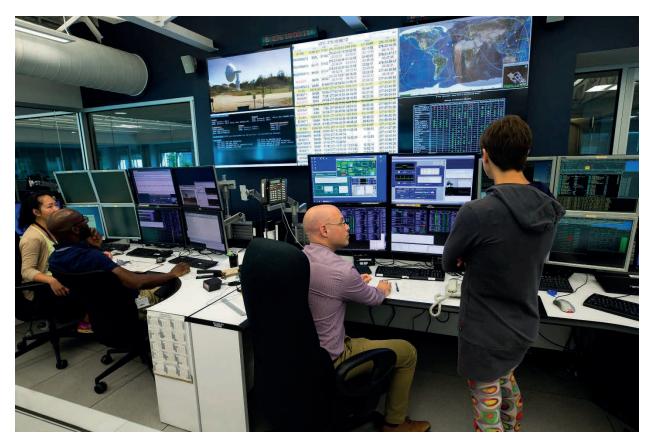


Figure 7 The Satellite Operations Control Centre of the Canadian Space Agency. (Credit: Canadian Space Agency)

In the decades since its formation, the CSA has continued to operate the Canadarm2 onboard the ISS, select world-class astronauts, and contribute to a wide range of spacecraft in Earth orbit and beyond.

Current (as of September 2022) Canadian Space Agency projects include the International Space Station, the Artemis Program, the RADARSAT Constellation, the James Webb Space Telescope, and robotic spacecraft on Mars and the Moon.



Figure 8 Canada's Fine Guidance Sensor (FGS) and the Near-Infrared Imager and Slitless Spectrograph (NIRISS) at NASA's Goddard Space Flight Center. (Credit: NASA)



# 3. The Canadian Astronauts

# The First Group

In the 1980's, through the contribution of Canadarm 1 to the USA's Space Shuttle program, Canada was invited to have Canadians as part of the new Space Shuttle program and to fly on missions. The problem was, Canada needed to hire and train their own astronauts for these missions. Thus, in 1980 a small job advertisement appeared in newspapers across Canada, reading "Astronauts Wanted".

From the over 4000 applicants for the job, six Canadians were selected in December 1983 to be the Canadian astronauts to fly in the Space Shuttle Program. The first group of Canadian astronauts included Dr. Marc Garneau, Dr. Steve MacLean, Dr. Bjarni Tryggvason, Dr. Robert Thirsk, Dr. Ken Money and Dr. Roberta Bondar.



Back row, from left to right: Ken Money, Marc Garneau, Steve MacLean and Bjarni Tryggvason. Seated: Robert Thirsk and Roberta Bondar. (© Canadian Space Agency)

Dr. Marc Garneau, who has a doctorate in electrical engineering and was a Navy Captain in the Canadian military, became Canada's first astronaut is space when he flew aboard the Space Shuttle Challenger as Payload Specialists on mission 41-G in October of 1984. After his initial flight, Dr. Garneau made two additional flights into space: STS-77 in 1996 and his final flight on STS-97 in 2000. Dr. Garneau took on the role of President of the Canadian Space Agency from November 22, 2001, to November 28, 2005, becoming the first Canadian astronaut to take on this role.

Dr. Roberta Bondar became Canada's second astronaut and the first Canadian woman in space when she flew aboard the Space Shuttle Discovery during mission STS-42 in January of 1992. This was Dr. Bondar's only flight, as she left the astronaut program shortly after her flight in September of 1992 to pursue her research in neurology.

Dr. Ken Money, was Dr. Bondar's backup to mission STS-42. While Dr. Money made many contributions to human space flight, he never did have a space mission and retired as a CSA astronaut in the fall of 1992.



Dr. Steve MacLean, flew on Space Shuttle Columbia as a payload specialist for mission STS-52 from October 22 to November 1, 1992. He then later journeyed a second time into space on board the Space Shuttle Atlantis on mission STS-115 in September 2006. Dr. MacLean took on the role of the President of the CSA for a period of time and resigned from the CSA on June 5, 2013, to pursue other interests.

Dr. Bjarni Tryggvason had his one and only space flight aboard the Space Shuttle Discovery mission STS-85 in August of 1997. He performed numerous fluid science experiments, one of his specialties, during the mission.

Dr. Robert (Bob) Thirsk flew to space twice, once as a payload specialist aboard the Space Shuttle Columbia mission STS-78 in June/July 1996 for a 17-day flight, and then once again for the first long duration stay for a Canadian, of 188 days in space, on the International Space Station as part of the Expedition 20/21 crew from May 27 to December 1, 2009.

### The Second Group

In 1992, the newly established Canadian Space Agency (CSA) announced their second astronaut recruitment drive. Out of the over 5000 applications that the CSA received, only four applicants were selected to become the new astronaut selections for Canada. Those individuals were Dr. Dave Williams, who is a medical doctor; Julie Payette, who has a Bachelor of Engineering degree and a Master of applied science – computer engineering; Colonel Chris Hadfield, an F-18 pilot/test pilot with degrees in engineering and aviation systems; and Michael McKay, an Aeronautical Engineer.



Back row, from left to right: Col. Chris Hadfield, Dr. Dave Williams. Front row, from left to right: Michael McKay, Julie Payette (© Canadian Space Agency)

Colonel Chris Hadfield had his first space flight as a Mission Specialist on the Space Shuttle Atlantis as part of mission STS-74 in November of 1995. This mission was the second shuttle docking mission to the Russian MIR space station, making Chris Hadfield the only Canadian astronaut to have visited this



Russian space station. In April 2001 Colonel Hadfield made his second flight to space aboard the Space Shuttle Endeavor as a Mission Specialist on mission STS-100. During this mission Colonel Hadfield helped to install the Canadarm2 on the International Space Station (ISS) and performed two spacewalks. This was the first time any Canadian did a spacewalk! His final mission to space was his assignment to Expedition 34/35, the second long duration space stay for a Canadian, from December 19, 2012, to May 13, 2013. During the second half of his 5-month stay Colonel Hadfield would take on the role as Commander of the International Space Station, a Canadian's first. Colonel Hadfield retired from the CSA on July 3, 2013.

Julie Payette had her first space flight in May/June 1999 on the Space Shuttle Discovery as part of mission STS-96, the first manual docking of the Shuttle to the ISS. In July of 2009, Julie Payette had her second flight to space aboard the Space Shuttle Endeavor, mission STS-127, marking the 29<sup>th</sup> Shuttle mission to the ISS. During Julie's STS-127 mission there were two Canadians on the ISS at the same time, Julie Payette and Robert Thirsk (from the Expedition 20/21 crew). Julie Payette retired from the CSA in July 2013.

Dr. Dave Williams experienced his first space flight as Mission Specialist 3 aboard the Space Shuttle Columbia on mission STS-90 in April 1998. His second flight came in August 2007, when Dr. Williams was a Mission Specialist on mission STS-118. This flight marked the Space Shuttle Endeavor's 20<sup>th</sup> flight and the 22<sup>nd</sup> Shuttle flight to the ISS. Dr. Williams retired from the CSA on March 1, 2008.

Michael Mckay, while being selected as a Canadian astronaut in 1992, resigned in 1995 but stayed active in the field until 1997. He did not fly in space.

### The Third Group

A third and smaller group of new astronauts were selected in May of 2009 from over 5000 applicants for the position. The new astronaut recruits were Canadian Forces fighter pilot Colonel Jeremy Hansen, who holds a Master of Science in Physic degree, and Dr. David Saint-Jacques, who holds an B.Sc. in engineering physics, a Ph.D. in astrophysics and has a medical degree.



Jeremy Hansen (© Canadian Space Agency)



Dr. David Saint-Jacques



Dr. David Saint-Jacques flew to the International Space Station as part of the Expedition 58/59 crew for a 204-day mission, the longest stay to date for a Canadian in space, that ran from December 3, 2018, until June 24, 2019. This has been David's only space flight to date.

Jeremy Hansen is still awaiting his first flight assignment into space, but he was the first Canadian to lead the training of new astronaut candidates in the NASA astronaut training program.

### **Fourth Group**

A fourth group of Canadian astronauts were selected in June 2017, after a selection process that started the previous year. The two new astronauts are Colonel Joshua Kutryk, a test pilot/fighter pilot in the Royal Canadian Air Force who holds numerous degrees in engineering and space studies, and Dr. Jennifer (Jenni) Sidey-Gibbons, who holds a Ph.D. in engineering. Both new Canadian astronauts were born and raised in the province of Alberta. Joshua Kutryk is originally from a place near Fort Saskatchewan and Jenni Sidey-Gibbons is from Calgary.



Astronauts Joshua Kutryk (left) and Jennifer Sidey-Gibbons (right). (© Canadian Space Agency)

While Jeremy Hansen, Joshua Kutryk and Jenni Sidey-Gibbons are all awaiting word on their first flight assignment, one of these individuals will be selected to be Canada's astronaut on the Artemis 2 mission and the chance to fly around the Moon in 2024! Who do you think it will be?



### 4. Canada's Role in Artemis

The Artemis Program is a NASA-led effort to return humans to the lunar surface for the first time since the conclusion of Apollo's lunar landings in 1972. Developed from technologies demonstrated in the cancelled Space Shuttle and Constellation programs, the Artemis era's Space Launch System (SLS) rocket will be the most powerful rocket ever flown by NASA. NASA and their industry partners have designed the Orion capsule to house crews on deep space missions to the Moon and beyond. For crewed landing on the Moon, NASA has awarded SpaceX a contract to develop the Human Landing System. When used together in upcoming lunar missions, the Space Launch System, Orion capsule, and Human Landing System will enable the landing of the first woman and next man on the surface of the Moon.



Figure 9 SLS Rocket Rolls to the Launch Pad. (Credit: NASA/Kim Shiflett)

With Artemis, NASA and several international partners, including the Canadian Space Agency, will establish a sustainable human presence at the Moon by constructing an orbiting space station, the Lunar Gateway. Canada will be contributing the Canadarm3 to the Lunar Gateway. The Canadarm3 will be a next-generation robotic manipulator with more agility and capability than the Shuttle Remote Manipulator System (Canadarm) of the Space Shuttle era or the Space Station Remote Manipulator System (Canadarm2) onboard the International Space Station. Unlike the International Space Station, which astronauts have continually inhabited since 2000, the Lunar Gateway will only host astronauts temporarily. To build and maintain a space station around the Moon, the Canadarm3 will leverage artificial intelligence and sophisticated hardware to operate autonomously. This 8.5-meter-long robotic arm will be able to move Lunar Gateway modules, assist astronauts during spacewalks, and inspect the Lunar Gateway. The Canadarm3 is being constructed by MDA, who previously built the Canadarm2 and



now owns Spar Aerospace, which made the original Canadarm.

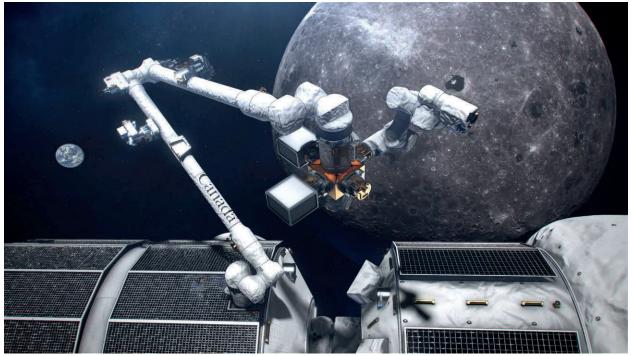


Figure 10 An artist concept of the Canadarm3 on the Lunar Gateway. (Credit: CSA)

As a result of Canada's contribution of the Canadarm3, two Canadian astronauts will be visiting the Moon on Artemis missions. The first Canadian astronaut to fly to the Moon will be onboard Artemis II, the first crewed test flight of the Space Launch System rocket and Orion Capsule. This free-return trajectory trip around the Moon will have four astronauts in the Orion Capsule, three of which are from NASA and one from the CSA's Astronaut Corps. Another Canadian astronaut will visit the Lunar Gateway as part of a future Artemis mission that may include a crewed lunar landing with the Human Landing System.





Figure 11 Canadian Space Agency astronauts Jenni Sidey-Gibbons and Joshua Kutryk celebrated the end of their basic training, along with their NASA classmates, during a ceremony at the Johnson Space Center in Houston, Texas. (Credit: NASA)

Canada's development of robotic systems for lunar exploration also includes rovers that are planned to explore the Moon's south pole. The lunar south pole is particularly interesting due to water ice frozen within permanently shadowed craters. To explore these dark, mysterious craters, Canada is participating in NASA's Volatiles Investigating Polar Exploration Rover (VIPER), which will map water content in the Moon's craters. The Canadian Space Agency has also awarded contracts to two Canadian companies, Canadensys and MDA, for the development of lunar rovers to be launched as soon as in the next five years. These regions near the lunar south pole are also the planned locations for the crewed lunar landing during the Artemis III mission.



Figure 12 An artist's concept of VIPER on the lunar surface. Equipped with headlights, VIPER will help determine the distribution of ice water on the surface and subsurface down to depths of one metre. (Credit: NASA Ames/Daniel Rutter)

Additionally, Canada is a signatory of the Artemis Accords, a United States-led initiative to encourage and promote collaboration in lunar exploration and international partnership with their ambitious Artemis Program. Canada was among the first of twenty-one (as of September 2022) nations to sign on to the Artemis Accords and agree to a peaceful, cooperative pursuit of space exploration, space resource utilization, and space colonization.





Figure 13 Artemis Accords signatories. (Credit: NASA)

Canada has positioned itself as a leading nation in the future of lunar exploration through their contributions of astronauts and robotics to the Artemis Program and its political support for the Artemis Accords.



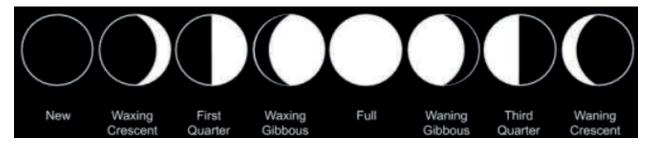
### 5. Moon Facts

The Moon is Earth's satellite. Another name for the Moon is Luna. It orbits Earth at approximately 385,000 kilometers and it takes 27.3 days for the Moon to orbit around Earth one time.

The Moon is 3,475 km in diameter in comparison to Earth's 12,742 km diameter. Approximately 4 moons could fit across planet Earth and approximately 50 moons could fit inside the whole planet Earth.

The temperature on the Moon can vary a lot depending on whether it is daytime or nighttime. Day time temperatures can reach up to 120 degrees Celsius and nighttime temperatures can get as low as -130 degrees Celsius. That is a 250 degree difference! Therefore astronauts must wear a spacesuit on the Moon.

The Moon does not emit its own light. The reason why we can see the Moon at night is because it reflects the suns light. However, we do not always see a full moon, and this is due to the lunar cycle. The Moon progresses through 8 different lunar phases over the course of 29.5 days. This is called the "Lunar Cycle". The first lunar phase is called the "New Moon" phase and the Moon then progresses through the remaining 7 phases as follows:



The Moon has a rocky and solid surface that you could stand on. It has a very thin atmosphere that we cannot breathe. This is another reason why you need a spacesuit to walk on the Moon. The most famous mission to the Moon was the Apollo 11 mission in 1969. This marked the first time a human had set foot on the Moon. There was a total of 14 Apollo missions, 6 of these missions resulted in humans walking on the Moon. In fact, a total of 12 humans have walked on the surface of the Moon. The first was Neil Armstrong in 1969 and the last was Eugene Cernan in 1972.

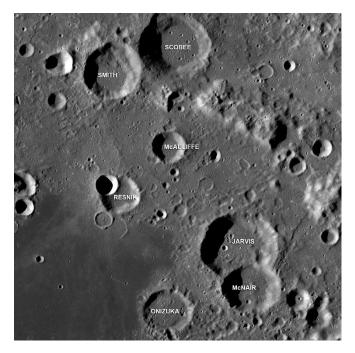


On average there are 2 lunar eclipses a year, although there can be more. A lunar eclipse occurs when the Sun, the Earth, and the Moon perfectly align with the Earth being directly in-between the Sun and the Moon. When this alignment occurs, the result is the Earth's shadow is cast upon the Moon. The Moon appears to be darkened and it can even result in the Moon to appear red in colour, hence the nickname "blood moon" given to the Moon during a lunar eclipse.



Partial Lunar Eclipse photo taken by Frank Florian

The Moon is covered in craters. Due to the lack of atmosphere on the Moon, whenever an asteroid or meteor heads directly towards the Moon, it usually makes contact with the surface, rather than burn up in the atmosphere like it would on Earth. These collisions result in the Moon's surface being covered in craters.



Challenger Astronauts Memorialized on the Moon. Photo taken by Nasa.



# 6. Educational Resources and Activities

# "OREO" PHASES OF THE MOON

GRADE LENGTH OF ACTIVITY

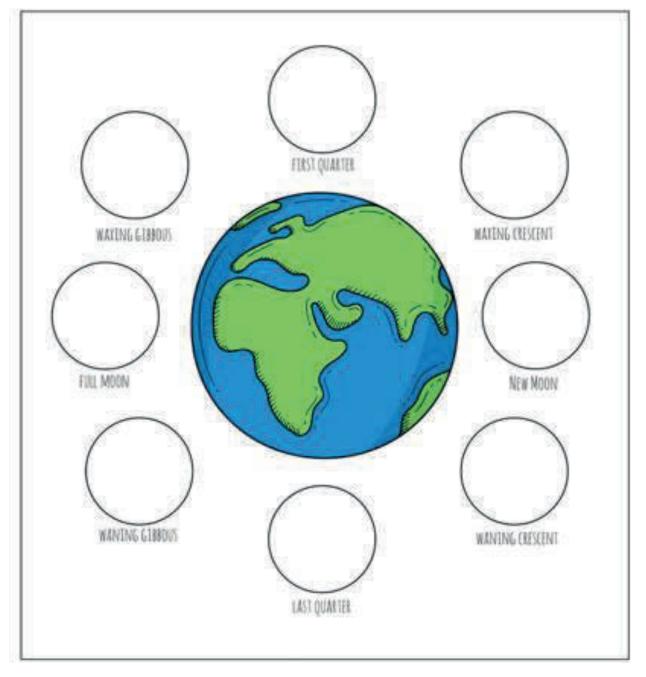
4-6 30 minutes

# **OVERVIEW**

SUPPL	IES	٠	PREP NOTES
•	Oreos Spoons Phases of the moon worksheet	•	Have 7 Oreo cookies, 1 spoon, and 1 worksheet per student
DESCR	IPTION	•	
2. 3. 4. 5.	Explain why we always see the same side of the moon and some lunar cycle facts. (see Background Info) Go over and name the 8 lunar phases (see Background Info) Have students wash their hands since they will be handling food next. Each student will get their Oreos. The task is to create all lunar phases they with Oreos. The cookie will be the shaded part of the moon and the cream will be that part of the moon that we can see. Using the Oreos pieces and the spoon, create all 8 lunar phases and put them on the worksheet according to their proper names. It is not necessary, but students can eat them afterwards.	•	Some students may not be able to eat the Oreo cookies due to the following Oreos are NOT Gluten Free Oreos are NOT Dairy Free Oreos ARE nut and peanut free
https://www.youtube.com/watch?v=2YJCtJPaeOk THIS VIDEO DEMONSTRATES SOMEONE COMPLETING THE ACTIVITY		•	Some background info. Don't show to students.



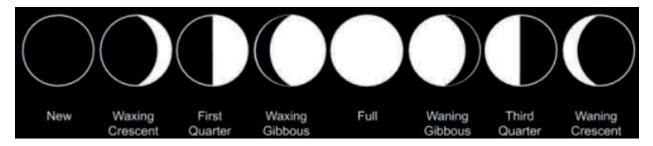






# **BACKGROUND INFORMATION**

The moon does not emit its own light. The reason why we can see the moon at night is because it reflects the suns light. However, we do not always see a full moon, and this is due to the lunar cycle. The moon progresses through 8 different lunar phases over the course of 29.5 days. This is called the "Lunar Cycle". The first lunar phase is called the "New Moon" phase and the moon then progresses through the remaining 7 phases as follows:



We always see them same side of the moon because the moon also rotates, along with Planet Earth. The moon rotates at the perfect speed so that we always see the exact same side of the moon. The other side of the moon, which we cannot see, is often referred to as "the Dark side of the Moon".

https://www.youtube.com/watch?v=csd rOZPkik



# CARDBOARD CANADARM

# AGE LENGTH OF ACTIVITY

Grade 1-4 30 minutes

# **OVERVIEW**

Students will build a cardboard Canadarm out of "linkages" and brass fasteners

SUPPLIES	PREP NOTES	
<ul> <li>4inch X 1inch Cardboard (4 pieces)</li> <li>Brass Fasteners (4)</li> <li>Scissors (for older students)</li> </ul>	<ul> <li>Teacher may want to prep the materials for younger students beforehand. Each student will need 4 pieces of cardboard (4inches by 1 inches) with wholes punched in the middle and towards the end of one side</li> </ul>	
DESCRIPTION		
<ul> <li>When you're ready to make a link, double check that the cardboard strips are overlapping, make sure your project is over a work mat, then carefully use an awl, or scissors, or whole punch, to punch a hole through the cardboard.</li> <li>Then take a brass fastener and put it through the hole, and spread the two leaves on the back side of the hole.</li> <li>You will be using the 4 cardboard pieces to make a "scissor" Linkage. This linkage can be used to clamp and pick up certain objects.</li> </ul>		
EXTENSION	SAFETY	
<ul> <li>Now that you're done, feel free to use your Canadarm to pick some objects up!</li> </ul>	<ul> <li>Because this activity requires using scissors, take necessary precaution to avoid cuts and injuries.</li> </ul>	

Source: <a href="https://www.asc-csa.gc.ca/eng/canadarm3/about.asp">https://www.asc-csa.gc.ca/eng/canadarm3/about.asp</a>



# EDIBLE LUNAR ROVER

# AGE LENGTH OF ACTIVITY

Grade 4-6 30 minutes

# **OVERVIEW**

Students will build a Lunar Rover replica out of edible materials!

SUPPLIES	PREP NOTES
Frosting/chocolate spread	
Oreos / round cookies	
Crackers / larger cookies	
Small candy	
(Optional) Toothpicks	
DESCRIPTION	
<ul> <li>Use a cracker as the base of your rover</li> </ul>	
<ul> <li>Using the icing/spread, attach four Oreo</li> </ul>	
wheels/round cookies to your base. Be	
careful, frosting isn't a very strong glue!	
<ul> <li>Now that you've got the basics, look at the</li> </ul>	
Lunar Rover model and try to replicate some	
of its other tools with any candy that you	
have.	
EXTENSION	SAFETY
<ul> <li>Now that you're done, feel free to eat your creation!</li> </ul>	<ul> <li>If you're using toothpicks, be careful not to poke yourself with them and to remove the toothpicks before eating your rover</li> </ul>

Source: <u>https://www.asc-csa.gc.ca/eng/astronomy/moon-exploration/viper-rover-mapping-water-ice-on-moon.asp</u>



# WHAT WOULD YOU BRING TO THE MOON FOR 40 DAYS AND 40 NIGHTS?

GRADE LENGTH OF ACTIVITY

1-6 20-30 minutes

# **OVERVIEW**

SUPPLIES	PREP NOTES
<ul> <li>This activity is a classroom discussion that requires no materials</li> </ul>	•
DESCRIPTION	•
<ol> <li>Have a classroom discussion as to what you would need to bring to the moon in order to survive a 40-day trip.</li> <li>Go around the room and have each student name one item. Items cannot be repeated. The students will need to work together to bring everything they think they would need in order to survive the trip.</li> <li>Once every student has named an item, discuss the list they created as a class and see if anything is missing. Do they need to all bring one more item each? Did they pack enough the first time around?</li> </ol>	•



# 7. Appendix / Additional Learning Resources

The RASC Observatory at The TELUS World of Science – Edmonton

Do you want your students to see the Moon through telescopes at The RASC Observatory? Then come and visit through the year to view the Moon and the other wonders of the night and daytime sky through various types of telescopes.

The RASC Observatory is open during the following Dates and Time:

September to June					
Friday & Saturday nights:	7:00 p.m. – 10:00 p.m.				
(Additional nights may be added through the year)					
July & August (summer hours)					
Friday & Saturday nights:	8:15 p.m. – 11:45 p.m.				
Monday – Sunday, days:	1:15 p.m. – 4:45 p.m.				

All times of The RASC Observatory are weather dependent and will not be open if:

- The sky is overcast.
- It is raining or snowing.
- The temperature is below -10° Celsius.
- The wind is too great.

The RASC Observatory is an outdoor activity, so please dress for the weather conditions at the time of your visit.

If teachers would like to visit The RASC Observatory during their school visit to The TELUS World of Science – Edmonton, then please inform our advance sales staff of your interest to do so at the time of your booking and staff will see if that would be possible. Opening The RASC Observatory on the day of the visit will depend upon the weather conditions for the day.



(Image of The RASC Observatory at TELUS World of Science - Edmonton)



### Internet Learning Resources

There are numerous learning resources on the Internet and through other sources that will greatly aid in the delivery of additional activities and learning experiences for students and teachers alike regarding the Artemis missions and the Canadian contributions to it. The following are links to some of these resources that one might useful:

# **Canadian Space Agency**

### https://www.asc-csa.gc.ca/eng/

General Information with links to various topics <u>https://www.asc-csa.gc.ca/eng/astronomy/moon-exploration/framework-future-space-exploration-activities-background-info.asp</u> <u>https://www.asc-csa.gc.ca/eng/astronomy/moon-exploration/artemis-information-kit.asp</u>

# Videos about the Moon Missions

https://www.youtube.com/watch?v=fghEZwmdVoI#GlobalNewsThe Moon Landing and the Maple Leaf: Canada's Contribution to Apollo 11https://www.nasa.gov/multimedia/nasatv/#publicNASA TV channel (live launches)https://www.asc-csa.gc.ca/eng/search/video/watch.asp?v=1\_mx7pigjhCanadians to the Moonhttps://www.youtube.com/watch?v=DG0S3knb-28The past and future of lunar exploration

https://www.youtube.com/watch?v=CMLD0Lp0JBg Artemis mission live launch videos

# NASA Artemis Mission Information, Resources and Activities

General Information about Artemis <u>https://stem.nasa.gov/artemis/</u> <u>https://www.nasa.gov/specials/artemis/</u> <u>https://www.nasa.gov/stem-ed-resources/forward-to-the-moon-explorer-activities.html</u>

Forward! To the Moon pre or post show classroom activities in pdf format <a href="https://www.nasa.gov/sites/default/files/atoms/files/forwardmoonexploreractivities-1.pdf">https://www.nasa.gov/sites/default/files/atoms/files/forwardmoonexploreractivities-1.pdf</a>

NASA STEM Engagement https://www.nasa.gov/stem/nextgenstem/moon/index.html

Royal Astronomical Society of Canada Lunar Observing Program <a href="https://www.rasc.ca/">https://www.rasc.ca/</a> (general website)



<u>https://www.rasc.ca/observing/explore-the-moon-observing-certificate</u> (RASC lunar observing activities as pdfs)

Free computer software to explore the Moon

https://ap-i.net/avl/en/start

Virtual Moon Atlas, A great way to explore the Moon.

