National Engineering Month 2014 Meeting Plan
"Mission to Mars"

Age 7-11

Duration: 1 hour 20 Minutes

National Engineering Month takes place during the whole month of March. It is a national opportunity for engineering professionals to show young Canadians the true value of engineering, and what a fun and rewarding career it can be.

Premise of this meeting plan:
Humans have begun colonizing Mars. With this colonization comes a series of engineering challenges that must be addressed for the people to survive and thrive. During the process of colony building a large amount of supplies will be delivered from Earth, but the noise and dirt clouds thrown up by the rocket thrusters mean the rocket landing site must be a long distance from the colony. The main task then is to safely transport all the supplies from the rocket to the colony as quickly as possible to ensure that the harsh environment of the red planet does not adversely affect any of the parts.

National Engineering Month 2014 Crests are no longer available for purchase from www.e-patchesandcrests.com, but you we can create you a custom patch instead.

Training videos can be found on the **Mission to Mars- NEM 2014** YouTube Channel: http://bit.ly/1jnhjDQ.

Get involved by sending photos of your completed rovers to rmalmond89@gmail.com to post on our Pinterest board http://bit.ly/LGXRGR. Please provide a first name and age (and unit/troop name). Please confirm that anyone under the age of 18 featured in the photos has a completed photo release form allowing use of their photo.

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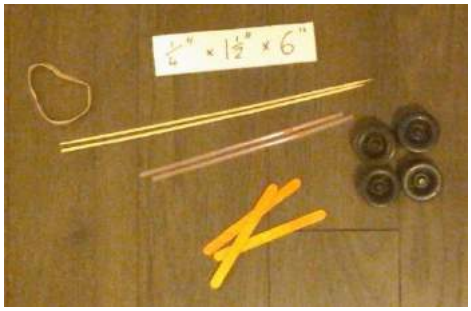
Materials List

Materials needed per participant:



4 wheels or bottle lids
1 Drinking straw
1 Bamboo skewer/ 1/8 dowel rods
1 Wood board platform cut to ¼" x 1 ½" x 6" (or foam board only 3 ½")
1 rubber band (long and thin work best)
2-3 Popsicle sticks
Cardboard, thick, thin, paper

Group supplies:

Rubber balls/ golf balls or eggs (load)
Tape
Hot Glue (optional but recommended)
Scissors
Pens/pencils

Working Space: Each child should have adequate table space to work on.

Test Area: This consists of three parallel strips of tape placed on the floor at 0m, 1 and 1.5m. For visual reference you can print the rocket and colony images at the end of this package and place them at 0m and between 1 and 1.5m respectively. The aim will be to land the rover/ device between 1 and 1.5m.

Advanced Test Area: This is the same as the Basic test area but should contain a rougher terrain. TO create this you may use a crinkled sheet of tin foil or tape strips of cardboard across the path to create undulations that the rover must travel over.

Recommended suppliers:

www.kelvin.com has a great selection of car kits and parts including a complete balloon rover bulk kit for groups.

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Warm-up Activities

Duration: 10-15 minutes

You may choose to do one or both of these activities depending on time. Complete activity resources are provided at the end of this package.

Activity 1: "Getting to Mars" Follow-the-leader story

Each person given a strip of paper with a 'when' and a 'Do' written on it, i.e. 'when: someone shouts blast off, Do: scream and cover your head'. See back of this pack for full actions.

The participants will need to pay attention to what is happening and what others are doing to make the story flow smoothly.

Learning objectives: All the participants must pay careful attention and work together to complete the tasks. Understanding of the journey needed from Earth to Mars.

Activity 2: True/ False Mars facts quiz

Continuing from the action story, the participants need to identify which of the facts about Mars are true or false.

Divide the room into two which one side being 'true' and the other 'false'. Give participants to the count of 5 (or 10 for trickier questions) to choose their answer by moving to the right side of the room.

Encourage participants to think for themselves or to discuss with others to figure out the answer.

Learning objectives: this quiz presents some interesting facts about space and the planet Mars. The questions give participants a chance to use prior knowledge, deductive reasoning and logic to determine if the facts are likely to be true. Some teamwork may be introduced by allowing participants to discuss answer selection.

Intro to activity and idea generation

Duration: 5-10 minutes

Lead in explanation from the quiz activity:

'You will need to have a Mars rover to explore the parts of the planet far away from the station.

As you move around in the rover you will gather samples of rock to be taken back to the laboratory. Very likely some will be 4 billion or 5 billion years old- as old as the solar system. Some of these will be very heavy, even with the low gravity, and you will need to carry them using your rover.

All the basic parts for the rover were sent with the cargo, but you need to put them together to build your rover. In the pack you have one rover platform, four wheels, two wooden rods, two tubes, some structural materials and an air power supply. How can you put these parts together to make a device that will help you get the rocks back to the laboratory?'

Ask the participants to think of ways to get the rocks (the ball or egg) back to the colony using only these objects. No ideas are too crazy at this time but after a few minutes try to guide the participants towards the idea of a car (if they haven't got there themselves).

How to power the car? Demonstrate the rubber band shooting it across the room. Explain how the stretched rubber band stores potential energy, like a battery stores electrical energy, which it changes into kinetic (movement) energy as it is released and contracts, causing it to fly across the room. How could we use this release of energy to make our rovers?

Show a sample of a finished rover and point out the different parts and what they do, e.g. the straws allow the wheels to turn freely, the skewer holds the wheels together etc.

Learning Objectives: to get the participants to think about different ways they could solve the same problem. Understanding of the basic principles of potential energy and propulsion.

Mars Rover Building Activity

Duration: 30-40 Minutes

Design rules

1. The rover must land within the bounds of the colony (between 1 m and 1.5m from the rocket landing site).
2. The package must be able to be removed from the rover at the colony without destroying the rover!

For younger participants demonstrate rover building or work step-by-step through the basic platform building (steps 1-6) as a group. For older participants (9+) provide a copy of the instruction sheet for the participants to follow by themselves. It is recommended to have an example rover for the participants to look at for clarity. Once the basic platform is built they can test their rover and make any modifications wanted.

Build the basic rover

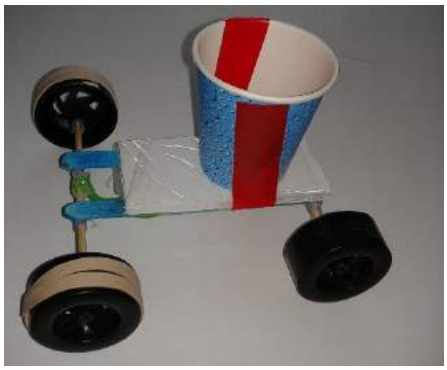
Step	Picture	Instruction
1		Tape or glue two popsicle sticks onto the platform with approximately ½" length sticking out from the top of the platform.
2		Cut one piece of straw roughly the same width as the platform. Tape or glue this to the end of the platform without the sticks.
3		Cut two pieces or straw the same width as the popsicle sticks. Tape or hot glue these pieces to the end of the popsicle stick protruding from the end of the platform.
4		Cut the skewer in two pieces approximately 1.5- 2 times the width of the platform. The additional length is needed to push into the wheels. Put one wooden dowel or skewer through each straw to create the wheel axle. It should rotate freely.
5		Put one wheel on each end of the dowel to complete the basic platform. Tape or hot glue the wheel to the skewer/dowel to ensure a secure fit. Check that the wheels still spin freely.
6		Loop the elastic band around the wheel axle between the popsicle sticks. Tie a knot and glue or tape the band in place. Tape the other end of the band to the mid-section of the platform. The basic rover should now be complete.

Design a rock holder

7. There is no standard method to attach the rocks to the rover.
   Suggestions: create a box from card to fit the ball. Cut and tape popsicle sticks to the platform to create a low barrier that will stop the rocks rolling off, use a small drinking cup to hold the package (if available)

Testing and refinement

8. Test the rover by winding the wheels with the rubber band attached (or pulling along floor to wind up) and then releasing to watch it go. Make adjustments as necessary.
9. Try fixing any failing parts of the rover to improve the performance. Design changes are acceptable, as are decorations!



Final Test/Competition

10. Remember the aim is to get the rocks back to the colony. Each rover will gets a single chance to deliver their rock to the colony area. Mark the location each rover lands in with a name sticker or tape.

Common problems and solutions

Rubber band is not winding up.
It is not fixed tight enough to the wheel axle.

The rover is not going straight
The wheel axle is likely too long. Put tape on the dowel either side of the platform to thicken the axle and prevent it sliding right and left. Make sure the axle still rotates freely.

The rover isn't going very far.
Check the thickness of the rubber band. A long thin rubber band will wind up easier and may produce more power. Also check what decorations or additions you added as these may impact the aerodynamics of the rover.

The wheels are spinning and the rover is not moving.
There may not be enough friction force between the wheels and the ground. Options are to make the rover heavier to give a greater reaction force, though this may affect the speed and distance of the rover, or to add a texture to the wheels or ground to help them grip, i.e. increasing the friction.

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Wrap up Discussion

Duration: 10-15 minutes

Topic	*Questions*	*Reflections*
Getting Supplies to the Colony	How many people got the supplies to the colony? How many didn't make it? How many went too far? Why did/ didn't your rover make it? What differences in rover designs helped or didn't help?	The aim is for the participants to see that the amount the rubber band is twisted determines how far the rover goes. The more potential energy that can be stored in the rubber band the more energy it can convert to kinetic energy when it is released. The shape of the rover will also have an impact on the performance by affecting the air flow around the rover (note this is not likely as big an issue on Mars where the atmosphere is much thinner). Any additions of friction surfaces to the wheels to help grip should be pointed out.
Storing supplies safely	Did anyone's package fall off their rover? Can everyone remove the package at the colony without destroying the rover? What package holder designs worked/ didn't work? How could you change something to make it work better?	Multiple different designs works, there is no single right answer. For the ones that didn't work there is always something you can to modify the design to make it better.
Using the rover on earth	Could you use this type of rover on earth? Where? Would it work the same or would you need to make changes to it? Do you think this would be better than the current options for transport and why? What other power options would be better than a rubber band?	This might be a cheap method of transport for developing countries as it doesn't use any non-renewable fuel sources, which makes it a clean technology and better for the environment. May need to add common transport features such as brakes and steering! Protection for the rubber band (to prevent over twisting and breaking) might be a good thing to add. Reflect on other renewable energy sources such as solar and wind, would either of these be better, would they still be reliable when the sun goes down etc. and how would that affect the people in relying on this technology to get supplies to them, get them to school etc.
Engineering	What is an Engineer?	Engineers are problem solvers.

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	What types of engineering are there and how would they be used to build our colony on Mars? How did it feel to be an engineer? **What kind of skills did you use that would be important for an engineer to have?** Do you think it would be fun to be an engineer?	Mechanical- outside rocket shell, mechanical air pumping systems Electronics- design the systems with switches, noise or light indicators. Software- to make all the computer systems work. Civil- layout and structure of buildings Energy- how to produce power And many more. All engineers have to work together to create the full system. Sometimes solving problems can be frustrating when it's going wrong but it's a really good feeling when you figure it out for yourself. The skills will be dependent on the group. Try to reflect on the activity and note any good examples you saw of these.

Engineering skills:

Teamwork	Working together during the story to make sure all the actions were done
Creativity	To come up with ideas for the rover and package carrier
Problem solving	To figure out why the rover isn't working and fix it
Resourcefulness	Being able to use just the materials we found in the supplies
Helping others	Without the engineer the rocks wouldn't have been able to reach the colony for testing!
Hands on skills	Being able to build something from scratch.

Background to National Engineering Month

There is nothing you can't do and there are no heights you can't reach, once you discover what engineering has to offer!

Engineering is more exciting than many think. It is truly all around us. When you drive across a bridge, fly a plane, use a computer or make a cell phone call, you experience the brilliant work of engineers. The results of their work can also be seen in satellites orbiting the Earth, on offshore oil rigs and in tall buildings rising from the world's metropolitan cities. Canadians can work more efficiently, play more safely and enjoy life more fully, thanks to engineers.

Engineers shape our future with forward thinking designs, new technologies and breakthrough developments that haven't been thought up yet. They prove, each and every day, that anything's possible.

National Engineering Month is the biggest national celebration of engineering excellence, where volunteers in each province and territory host over 500 events that show Canadians how rewarding the career choice can really be. During the month of March, the profession strives to reach out to young Canadians to let them know what an exciting and fun career choice engineering really is. It is an opportunity for youth to learn about many disciplines of engineering, and allow them to see where their skill set and interests are best fitted. Since there are so many areas of engineering, it's important for kids to understand the various things they can do as engineers so they can pick the discipline that truly motivates and excites them the most. Additionally, the month can teach youth what exactly is needed to excel in the profession.

National Engineering Month also gives students the opportunity to learn about the remarkable accomplishments Canada's engineers have made over the years. For more information you can check www.nem-mng.ca to see examples in the Great Canadian Engineering section to learn things like how engineering work pushes the boundaries of flight and contributes to amazing manmade structures, and the Engineers in Profile section to meet incredible engineers who have been conducting important work like allowing amputees to control their artificial limbs with ease and building earthquake resistant structures.

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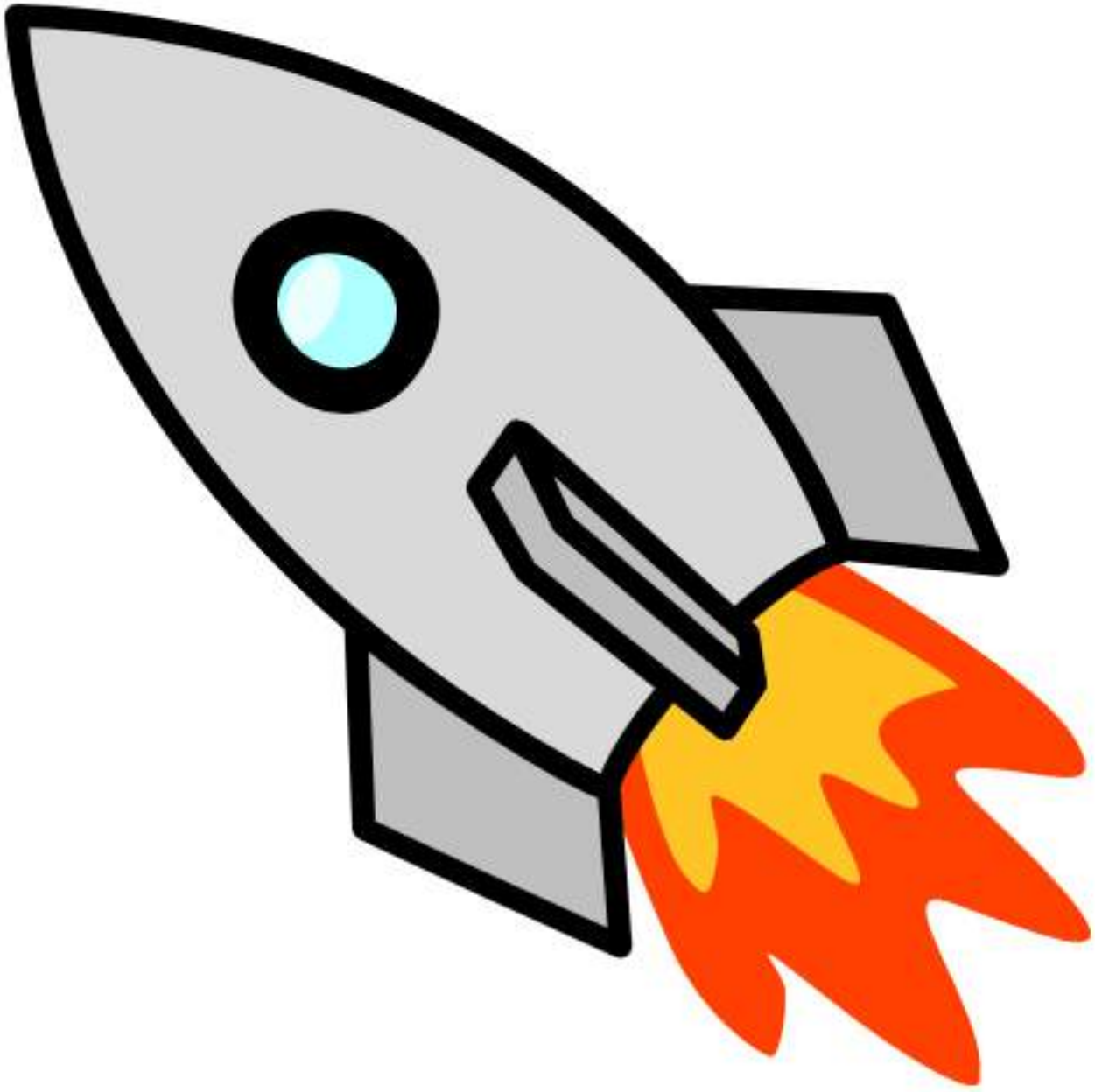

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Activity 1: "Getting to Mars" Follow-the-leader story

Start: In the last century Neil Armstrong became the first person to walk on the Moon. In the next decade people will start to live on Mars in a special colony, can you imagine being one of the first?

When you hear: "can you imagine being one of the first?"
Say: "astronauts to the shuttle for launch" then run to the center and sit down.

When you hear: "astronauts to the shuttle for launch"
Do: Run to the center and sit next to a partner as if in a rocket.

When you hear: "astronauts to the shuttle for launch"
Do: Run to the center and sit next to a partner as if in a rocket.

When you hear: "astronauts to the shuttle for launch"
Do: Run to the center and sit next to a partner as if in a rocket. When everyone is seated say "come in mission control"

When you hear: "come in mission control"
Do: Stand up and say "Mars One team you are ready for launch in 3, 2, 1, Blast off!"

When you hear "blast off"
Do: Stand up and lead anyone sat in the center back to the circle while making a rocket sound.

When someone makes a rocket sound
Do: Stand up and say "Mars one Team, this is the International Space station do you read"

When you hear "do you read"
Do: Stand up and say "We read, preparing for transfer to Mars rocket"

When you hear "transfer to Mars rocket'
Do: Take the hands of person to your right, kneel down and make an arch.

When you hear "transfer to Mars rocket'
Do: Join hands with anyone who join you in the center and crawl through an arch made by two people!

When you see people crawl through an arch
Do: Stand up and say "commencing travel to Mars"

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When you hear “travel to Mars”
Do: Stand up and hold this above you.

EARTH

When you hear “travel to Mars”
Do: Stand up and hold this above you.

MARS

When you hear “travel to Mars”
Do: Walk slowly from Earth to Mars, count months as you go “1 Month, 2 Months…. 6months”

When someone walks from Earth to Mars
Do: Stand up and say “coming in to land”

When you hear “coming in to land”
Do: Stand up and say “release the parachute”

When you hear “release the parachute”
Do: Stand up and say “fire the engines for braking”

When you hear “fire the engines for braking”
Do: Crash land’ in the center and say “we made it!”

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Activity 2: True/False Quiz

Now you are ready to explore Mars. Your mission to Mars is the first of many more. To help future astronauts it is important for your crew to discover as much as possible about the planet.

The first people to live on Mars will stay there for 10 years before they return to Earth.
False. The Mars One Project plans to only send the astronauts one way!

On Mars you will live in a special Mars colony with sections for living, sleeping, exercising and storage, a laboratory for conducting experiments and a place to grow plants.
True

The colony pieces were sent to Mars in smaller pieces years ago and put together by a robot before you arrived.
True

Gravity on Mars is twice as strong as on Earth.
False. Gravity is 1/3 as strong on Mars as on Earth. Your supply packs would be heavy on earth but here on Mars you can lift them easily. On Mars there is enough gravity for you to lie down to sleep without floating away.

There is air inside the station for you to breathe, so you don't need to wear your space suit.
True

Soon you are ready for bed. A Martian day is just a bit over 24 hours long so the day-night cycle is about the same here as on Earth.
True

After you get up you check every part of the station including the electric system. Electricity is generated by nuclear fusion.
False. It is generated by solar panels.

You make sure that the water recycler is working. Wastewater, water in the air and urine are purified. They are used over and over again.
True.

There are many volcanoes on Mars that erupt all the time.
False. But there are many extinct volcanoes. One of them is about 24 km high. It is the highest peak in the solar system and three times as high as Mount Everest, the highest point on earth.

Mars is as dry and dusty as a desert and it never rains.
True. We know that long ago mars had water. There are old riverbeds cut into the Martian rock. The flat area may have been an ocean. It never rains on mars because here is not enough water in the air. But it is likely that there is water below the surface of the planet. In some places there is a layer of ice. Below the ice there may be liquid water. It seeps out of the walls of a few craters. You will need to dig wells to recover the water, it will be one of your first jobs, because the crew need lots of water.

The Martian atmosphere is much thinner than our atmosphere.
True. Most of it is a gas called carbon dioxide.

Mars is much warmer than Earth.
False. Being further from the sun the planet is cold at about -60 degree Celsius. The north and south polls are even colder about -115 degrees Celsius. The poles are covered by ice and by white frozen carbon dioxide.

There are no plants on Mars- no animal's birds or bugs.
True. Did they exist there a long time ago? At some time during the history of Mars, living things may have developed on the planet. You will search for clues that let us know.

Many craters were dug when meteorite crashed into Mars. The planet was hit by them billions of years ago. Some of them were huge. One of the craters is at least 300 km across. That's as long as Lake Ontario!
True