National Engineering Month 2014 Meeting Plan
Mission to Mars

Age 12-18

Duration: 1 hour 45 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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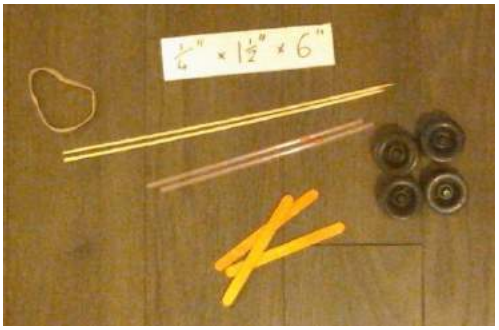
Materials List

Materials needed per participant:



Wheels or bottle lids
Drinking straws
Bamboo skewers/ 1/8 dowel rods
1 Wood board platform cut to ¼" x 1 ½" x 6" (optional)
Rubber bands (long and thin work best)
Balloons (optional)
Popsicle sticks
Cardboard, thick, thin, paper, foam board
Miscellaneous recycled bottles

Group supplies:

Rubber balls/ golf balls or eggs (load)
Tape
Hot Glue (optional but recommended)
Scissors
Pens/pencils
Measuring tape
Timer
Example rovers

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

Basic 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 Activity: Building a human colony on Mars

Duration: 20-30 minutes

Split participants into groups of 4 for this task. Provide each group with pieces to represent the colony buildings and a copy of the 'Background and colony information' which includes all the information they need to complete the task.

Materials

There is a paper template provided at the end of this pack which can be provided to the groups to represent all the modules and astronauts involved in this task, however for improved visualization and results the following materials are recommended:

1 Large Polystyrene hemisphere – control module
10 Medium polystyrene hemispheres – kitchen, work, living, health, greenhouse
16 Extra small polystyrene balls- astronaut sleeping areas
1 Polystyrene cube- air lock
Toothpicks/ bamboo skewers

In marker write the name of the module/astronaut and the number of doors onto each of the polystyrene parts. Participants can then physically attach modules together to solve the problem using the toothpicks to represent the connections between the module doors.

Aim of the task

Arrange the colony modules to avoid breaking any building rules and astronaut sleeping/working requirements.

* To simplify this task it is possible to eliminate the specific work requirements highlighted.

Learning objectives: The participants need to work together and use analytical thinking and some basic logic to determine the optimal layout for the colony to meet everyone's needs without breaking any of the rules. Can be linked to skills needed for many engineering disciplines including civil, software or industrial engineering.

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Background and colony information

To build a colony on Mars the Mars one team here on earth will be sending supplies, colony building modules and teams of four astronauts to Mars in a series of missions as follows:

Arrival schedule on Mars

Mission	Arrival Date	Contents
Cargo 1	2022	2 living units, 1 control module, 1 greenhouse, 1 kitchen, 2 work stations, 1 health module, 1 airlock
Humans 1	2025	Team 1- humans A, B, C, D
Cargo 2	2026	1 living unit, 1 work area,
Humans 2	2027	Team 2- humans E, F, G, H
Cargo 3	2028	1 living unit, 1 work area,
Humans 3	2029	Team 3 – humans I, J, K, L
Humans 4	2031	Team 4 – humans M, N, O, P

Building Modules

Each of the colony building modules has a number of doors which can be connected to a door on another module via corridors which the astronauts build with help from the Mars one rover. Each module generates its own power using solar panels, but not all have independent life support systems.

Modules	Description	# Doors
Control module	Main community meeting area, mission control, life support attached.	4
Greenhouse	Place to grow and harvest fresh foods.	1
Kitchen	For cooking, all astronauts will share this facility.	3
Health block	To maintain health and fitness, contains gym and medical supplies, all astronauts will share gym	3
Work area 1, 2, 3	Where astronauts carry out research, experiments and other work tasks.	2
Airlock	Airlock and receiving dock for astronauts leaving or entering the colony.	1
Living unit	Small living room, each has a life support unit attached and individual inflatable sleeping areas can be attached to doorways as required.	6
Sleeping area	This is an inflatable module which attaches to a single doorway and sleeps one person. Each area is assigned to a specific astronaut.	1

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Keeping Busy

While living in the colony each astronaut has specific tasks and responsibilities to carry out in particular work areas*:

Assigned Work area	Astronauts
Health Module	C, P
Greenhouse	A, G
Work Area 1	B, D, I, J, M
Work Area 2	H, L, O
Work Area 3	E, F, K, N

Colony building rules

1. No part of the colony should need to be disassembled to incorporate a newly arrived module.
2. Astronauts can only be assigned to living modules that arrived on Mars before they did.
3. The airlock module must be attached to the control module.
4. Bedrooms can only attach to living units.
5. Distance to communal areas (control, greenhouse, kitchen, health) should be equal for all Astronauts.
6. Astronauts should be able to move freely to all modules without exiting the station.
7. *Astronauts must not have to travel through more than 4 modules to reach their work area(s) from their living unit.

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Intro to activity and idea generation

Duration: 15 minutes

Due to the dust thrown up by the braking engines on the rockets the cargo landing site is a long distance from the colony. This helps prevent the dust from covering the solar panels. Explain that we need a reliable and repeatable method to transport new supplies to the colony site. We have limited resources and can only use what we can find around the colony- which is all the supplies in the materials list.

In small groups of 2-4 ask the participants to think of ways to get the supplies (the ball or egg) from the rocket to the colony using only these objects. Annotated sketches are recommended to help visualize and communicate ideas within the teams. Designs do not have to be limited to rovers and can include any method to get the supplies from the rocket to the colony safely e.g. catapult, ski lift, slingshot etc.

Show the example rovers from the younger age groups and explain how both the balloon and the stretched rubber band store 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 own devices?

How will the safety of the supplies be affected by each idea?

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.

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Device Building Activity

Duration: 45 Minutes

Design rules:

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

Teams should select a design direction from their discussion and begin building using the materials supplied. Participants are free to change or refine their designs as they progress. The test area should be available to test as required.

Younger participants may be encouraged to focus on trying to understand how the example rovers work and reverse engineer them, while focusing on improving their performance.

If applicable, using the internet or other sources to gather information is acceptable if all teams have equal access to the resource.

Final Test/Competition

Duration: 15-20 minutes

Remind the participants of the aims of the challenge and the rules.

Distance Test

Each team gets three chances to land the package in the colony area. For each try the distance will be measured and recorded. These will then be averaged to give the final score. Use the standard example rover as a base result for comparison. Explain that by averaging the results we can take into account the repeatability of the device to hit the same point each time.

Time test

Each team gets two chances. The fastest time will be counted. Only runs where the package arrives in the colony area should be counted.

Wrap up Discussion

Duration: 15-20 minutes

Topic	*Questions*	*Reflections/learning objectives*
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?	For a rover 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. For other designs that are not rovers ask the group to explain how it works and how they used the power source to make it reliable and the results repeatable.
Getting the package there 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.
Reliability and repeatability	How different were the solutions teams came up with? How reliable were they, were the results repeatable or did they vary widely? How safe would they be for people operating them (or standing nearby)? Could supplies returned to the rocket using the same design, or would it need modifying?	These questions will get the participants to think critically about their engineered performance from a user perspective and to consider the implications of the user experience on how the design might be perceived for safety and repeated use.
Using the rover on earth	Could you use this type of solution on earth? Where? Would it work the same or would you need to make changes to it? What would be the limitations of this solution or of the proposed changes? Do you think this would be better than	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 or other safety interlocks! Reflect on other renewable energy sources such as

	the current options for transport and why? What other power options would be better suited or would help to improve distance or time performance?	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? Who are some engineers we see in pop culture, do you think they are representative of most engineers? Is that good/bad? How did it feel to be an engineer? **What kind of skills did you use that would be important for an engineer to have?** What kind of school subjects do you think engineers need to know? Do you think it would be fun to be an engineer?	Engineers are problem solvers! 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. Also reflect on the fact that engineering is an applied science, i.e. it uses science and math principles such as potential energy in a practical way to do something useful. This means engineers need to have an understanding of subjects like math and physics.

Engineering Skills:

Teamwork	Working together to create a design and a finished product.
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 rocket
Helping others	Without the engineer the supplies wouldn't have been able to reach the colony!
Hands on skills	Being able to build something from scratch.

Background to National Engineering Month

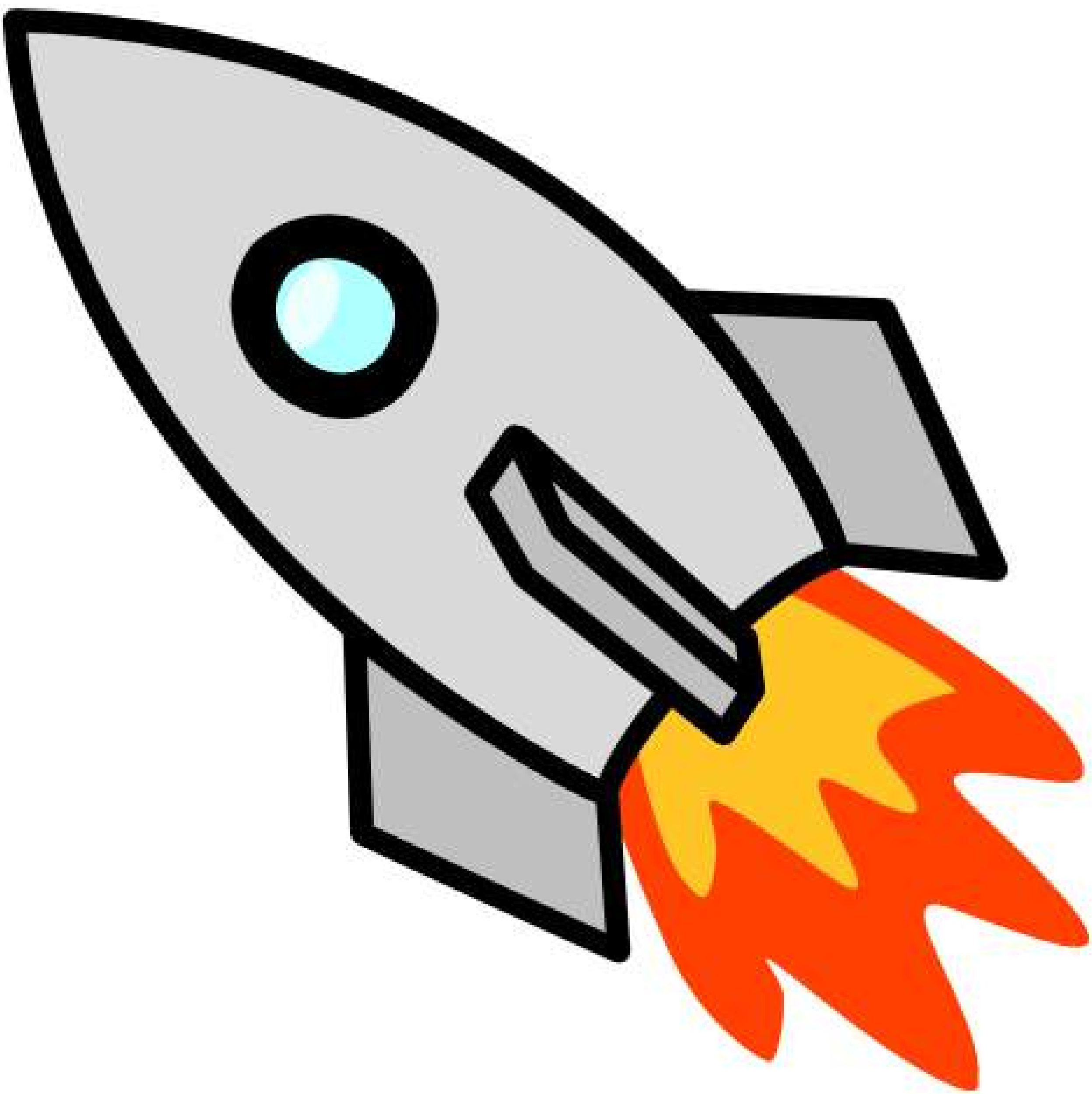
There is nothing you can't do and there are no heights you can't reach, once you discover what engineering has to offer!

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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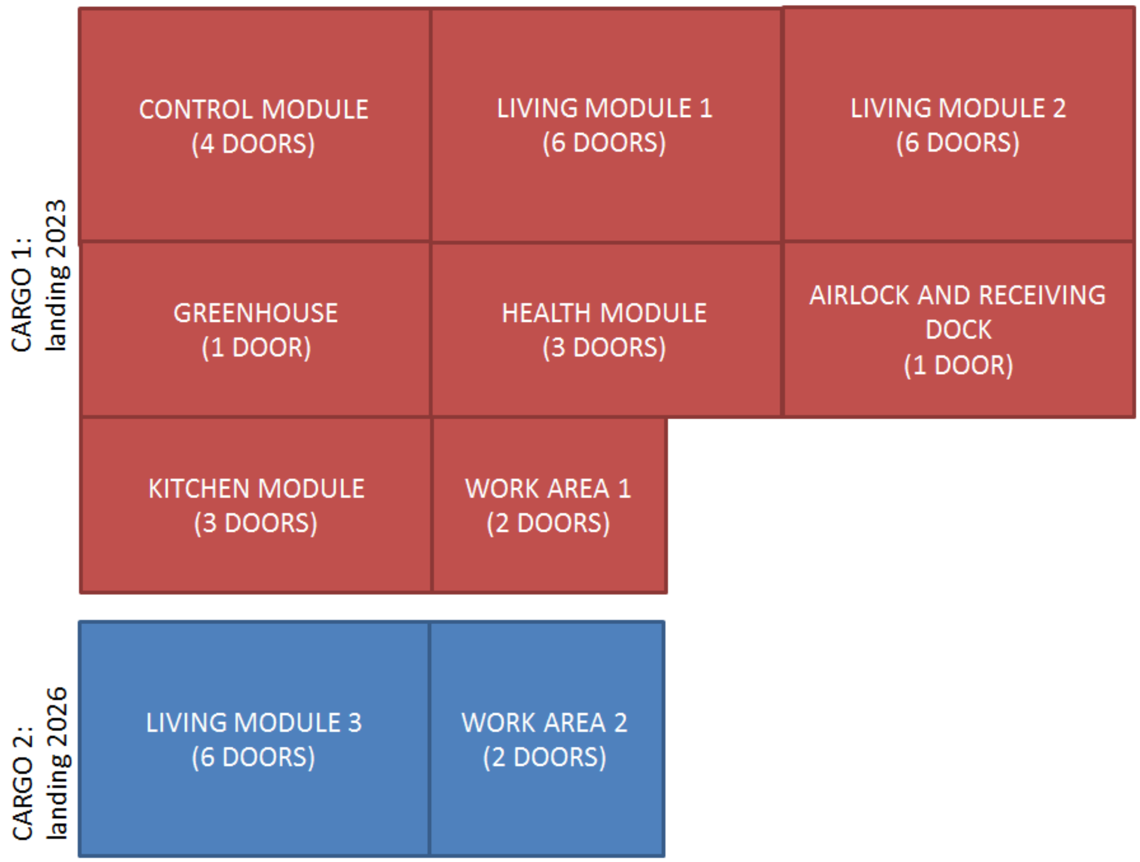
BUILDING A COLONY: COLONY MODULES



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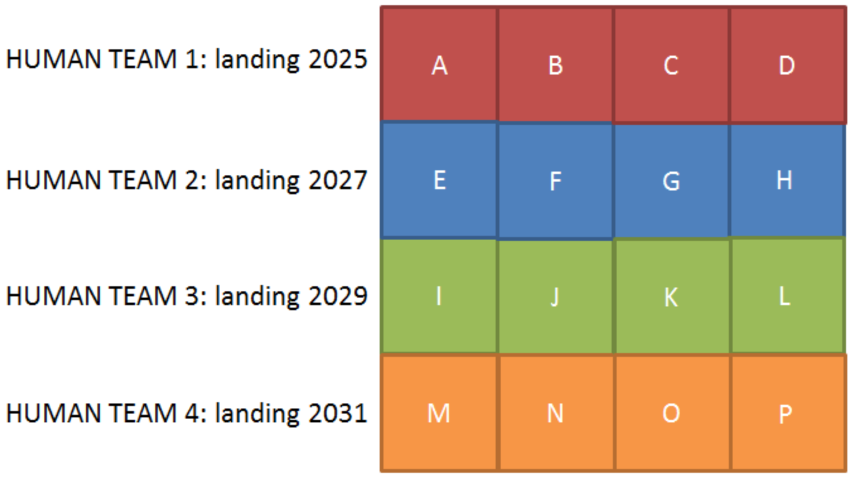

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