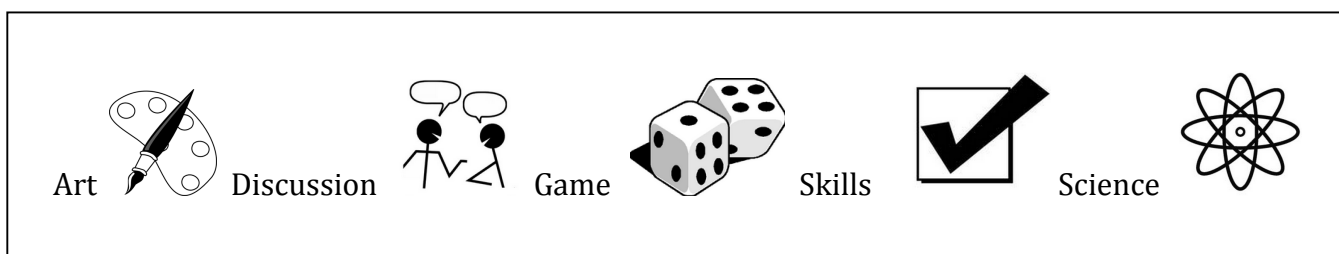


# Meeting-in-a-Box: Engineering

This meeting is aimed at **Brownies** and covers portions of the **Key to STEM** as well as other parts of the program. It was originally created for **National Engineering Month** (March) but can be used at any time of the year. There are enough elements for about **two and a half hours' worth of activities**, but you can pick and choose or run more than one meeting with this theme.



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## Supplies

- |  |   |
|--|---|
| <input type="checkbox"/> Lemons              | <input type="checkbox"/> Masking tape   |
| <input type="checkbox"/> Baking Soda         | <input type="checkbox"/> Paper clips  |
| <input type="checkbox"/> Cups                | <input type="checkbox"/> Tinfoil  |
| <input type="checkbox"/> Spoons              | <input type="checkbox"/> Small container  |
| <input type="checkbox"/> Sugar               | <input type="checkbox"/> Dominos or Jenga blocks and lego (optional)                  |
| <input type="checkbox"/> Lemon Juicer        | <input type="checkbox"/> Hair Dryer   |
| <input type="checkbox"/> Sturdy Paper Plates | <input type="checkbox"/> Baking soda  |
| <input type="checkbox"/> Markers             | <input type="checkbox"/> Cooking Oil  |
| <input type="checkbox"/> Pencils             | <input type="checkbox"/> Citric Acid (found in the canning section of grocery stores) |
| <input type="checkbox"/> Balloons            | <input type="checkbox"/> Ziplock bags   |
| <input type="checkbox"/> Paper               | <input type="checkbox"/> Mixing bowls   |
| <input type="checkbox"/> Popsicle sticks     |   |
| <input type="checkbox"/> Straws              |   |

### Activity 1: Intro

(5 minutes)

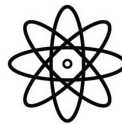


Start by asking questions:

- Do you know what an engineer is?
- Do you know any engineers?
- What kind of work does an engineer do?
- Can you name things around you that engineers were involved in making?

### Activity 2: Engineer your Lemonade

(20 minutes)

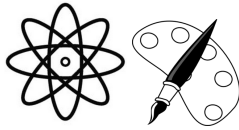


Have you ever made a rocket or volcano out of baking soda and vinegar? You're going to use the same science to make something to make the tastiest, coolest, sciencyest, engineeriest lemonade ever.

- Squeeze a lemon into a glass and add an equal amount of water.
- Stir in a teaspoon of baking soda
- Add sugar to taste

Take a sip and notice how fizzy your lemonade is. As you mixed the baking soda and lemon

juice you created a chemical reaction. Bases (baking soda) and acids (lemon juice) mix together to release carbon dioxide (CO<sub>2</sub>), which is the same gas as makes pop fizzy.



### **Activity 3: Hovercraft** (25 minutes)

Have you ever wanted your very own hovercraft? Now is your chance.

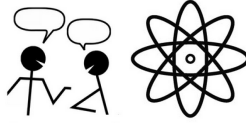
Use markers to decorate the underside of a paper plate before poking a pencil through the middle to make a hole.

Push the end of the balloon through the hole and blow it up. Don't tie a knot. Instead, hold it closed right above the plate and release it over a flat surface. You should be able to guide it by gently pushing the side of the plate.

As the air tries to escape from under the plate, it will cause it to rise slightly and thus hover over the surface. Real hovercrafts use the same principle with propellers instead of balloons.



<http://www.highlightskids.com/science-experiment/make-hovercraft#>



## Activity 4: Brave the wind

(25 minutes)

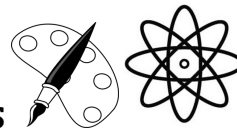
Divide Brownies into a few small groups and give them objects such as Jenga blocks or dominos to make a tower. Tell them that they are trying to make it both high and solid.

Engineers often have to think about how nature might affect the things they build. Once the towers are built, have the girls stand in front of them and blow. Do they fall over?

If they don't, use a hairdryer to see whether the buildings can stand stronger "winds." Start a ways off and move progressively closer with the hairdryer to see how much wind the towers can stand.

Discuss which structures were most solid and why. Can the girls think of any ways in which real buildings are built to withstand storms?

If you have time, try doing the same activity with lego and discuss why they hold together better. How could this apply to real buildings?



## Activity 5: Homemade Bath Bombs

(20 minutes)

In this activity, girls are going to be making bath bombs that they can take home and use at bath time. You may wish to divide the girls into small groups to do this so that they can all be involved.

1. Add  $\frac{1}{4}$  tsp of water to  $\frac{1}{2}$  cup of baking soda. Mix well.
2. Mix in 1 Tbsp of citric acid. You may notice a bit of fizzing or that the mixture gets cold. This is normal.
3. Add 1 tsp of cooking oil
4. Form into bath-bomb sized balls. The dough should be dry and crumbly but just stick together. If you need to, add  $\frac{1}{4}$  tsp more oil.
5. Write each girl's name on a ziplock bag so that she can take one home. They will be much more solid after drying overnight so wait at least 10 hours before using them.

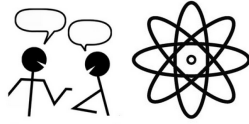
The girls can add them to their baths at home and watch them fizz in the water. They may also notice that the bomb gets cold as this is an endothermic reaction (one that takes in energy or heat). Warn parents to be careful because the oil in the bath bombs may make the tub slipperier than usual.

If you can, keep one bath bomb aside and show the girls what happens in a tub of water the next week once it has had time to dry.

This activity comes from: <http://www.funathomewithkids.com/2013/10/diy-bath-bombs-magic-hatching-dinosaur.html>

## Activity 6: Walk Around

(20 minutes)



Engineering can be found most anywhere.

Brainstorm a list of characteristics that you think indicate that something is a machine (levers, pulleys, wedges, screws, ramps, wheels, axles, pistons, gears, etc.).

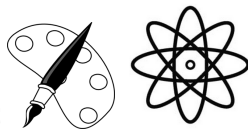
Use a dictionary to read the definition of a machine or read out the one below.

*A machine is defined as an apparatus using or applying mechanical power and having several parts, each with a definite function and together performing a particular task.*

Divide into teams and see how many machines you find around your meeting place or neighbourhood. After 10 minutes, come back and share with the group. What convinced you that the items you found were machines?

## Activity 7: Boats

(30 minutes)



Divide the girls into teams and show them the material below. Tell them that they have to build a boat that will hold a small container with marbles. They should think about how to make it float but also consider how solid it is, where the container will go, how the materials will change when they get wet and whether all team members are participating. The girls can look at the marbles and container but they cannot be built into their boats, as you will use the same ones for each team.

- 2 straws
- Tinfoil
- 50 cm of tape
- 5 paper clips
- 4 popsicle sticks
- 1 piece of paper

Give them a piece of paper and 5 minutes to plan before they get their material. After the time is up, give each team the material and 10 minutes to build their boat.

Then, in a washbasin filled with water, test out how many marbles each boat can hold before it topples or sinks.

## Program work completed

Activity	<b>Brownie Program Work Completed</b> * Please note that the program doesn't necessarily match up exactly with the numbers indicated, but that the activities accomplish similar goals
Introduction	Jobs in the Community B People in Science STEM Special Interest Badge
Lemonade	Be a Chef Fabulous Food C Caboosh! STEM Special Interest Badge
Hovercraft	Making Things Go STEM Special Interest Badge Super Crafts
Wind	Building Up STEM Special Interest Badge Super Crafts
Bath bombs	STEM Special Interest Badge Caboosh! Super Crafts
Walk Around	Turn it on Safely A STEM Special Interest Badge
Boats	STEM Special Interest Badge Super Crafts

*Meeting Submitted by Elizabeth Knowles with help from Robin Yee and Rachel Collins in February 2015*