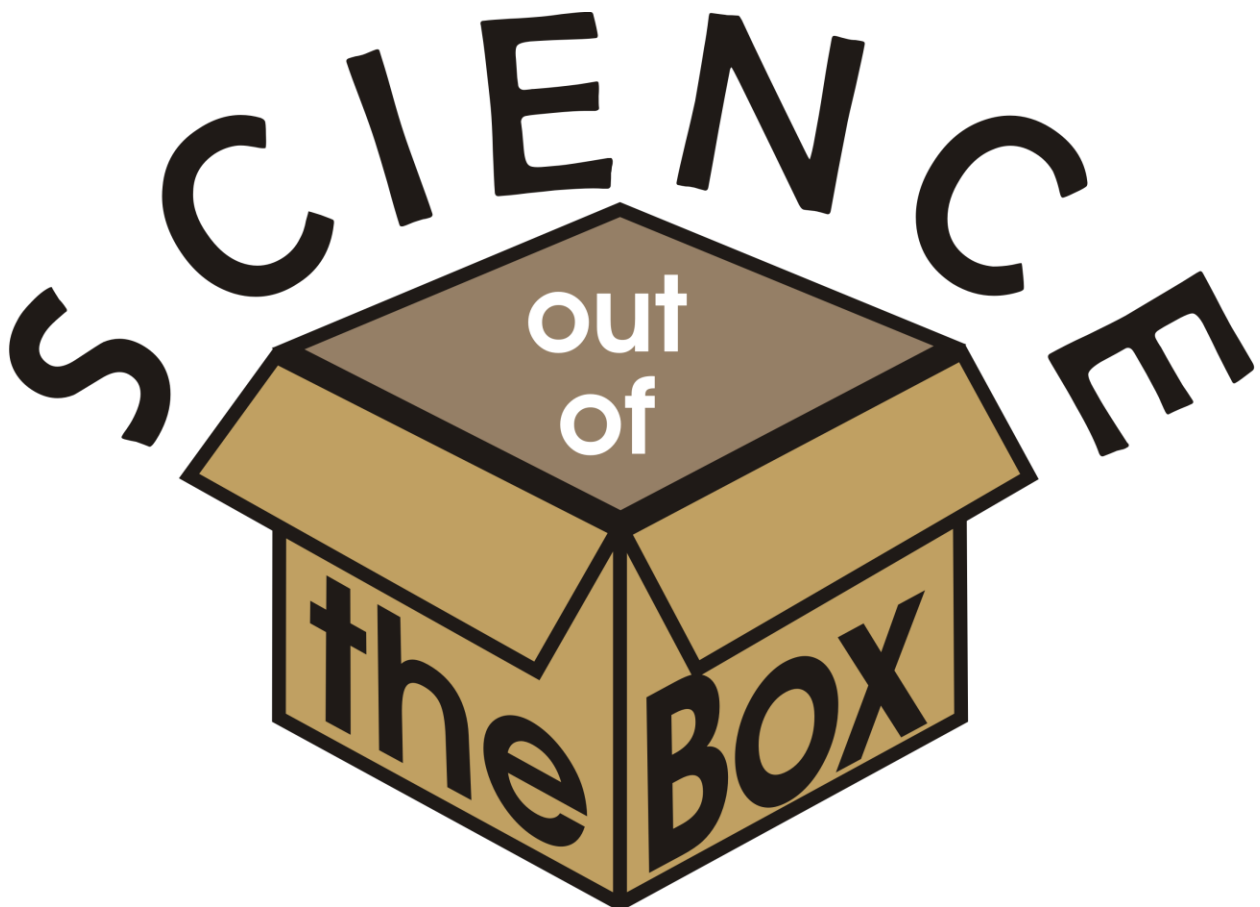


# SCIENCE OUT OF THE BOX

A SCIENCE RESOURCE  
FROM THE BC PROGRAM COMMITTEE

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*(Replaces "Science in a Box")*

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## INTRODUCTION TO SCIENCE OUT OF THE BOX

The BC Program Committee developed the original “Science in a Box” resource in 2003. This update to the “in a box” idea takes us “out of the box,” hence the change of name. If your district has the box that was distributed with the original Science in a Box resource, you may find some of the supplies useful. However, if the supplies have been depleted, you will find that the majority of the activities use common household items or supplies easily found at a dollar store, pharmacy or grocery store.



There have been many studies that show that when girls gain confidence in science and math, there can be no stopping them. As they increase their self-confidence, they tend to answer more questions in the classroom and end up receiving more attention in the learning process. We can give girls the power of knowledge in our all-female environment so that they are self-assured to explore all options in the rest of their lives. This does not mean that every girl needs to become an engineer or a chemist, but it opens more doors and opportunities.

### Science “In a Box” vs. “Out of the Box”?

In this update, we have added several science categories that were not specifically identified in the original resource: applied science, computer science, earth science, environmental science and forensic science are now included. Related activities in other BC Program Committee resources are referenced.

The technology category has been removed, with the intention that we are presenting this as a “science” resource only – some technology activities fall under the computer science category, but we refer to the **STEM Challenge: Technology** for related activities.

Additional reference information that had been included in the original “in a box” appendices has been removed. Most activities include a “**What’s Happening?**” section to explain the science related to the activity. Should you require additional background knowledge about a scientific topic, we urge you to research at your public library, online, or contact the BC Program Committee STEM Specialist at [program@bc-girlguides.org](mailto:program@bc-girlguides.org) with any questions.

Some activities included in the original resource have been renamed or removed. “Ack, It’s Gak” has been renamed to use the widely accepted name for this substance – Oobleck. Other activities were removed as they are very similar to, or duplicates of activities included in other BC Program Committee resources.

We hope that this updated resource enhances your science experience within your unit.

## What's in this Resource?

So, what can you expect in “Science Out of the Box”? This resource will provide you with information to carry out a number of activities on different topics that relate to science. Although we are not able to provide activities for every single branch of science in existence, we have tried to give a good cross section of activities for you. Science categories have been sorted alphabetically within the document. In Appendix 1, there is a list of references to books and website searches that can provide additional information.

If you read through this resource and say to yourself, “what in the world is that?” or “I have no idea what pH is myself, how am I going to do an experiment about it?” don't worry. Science concept information is included with each activity. Choose the activities that you feel most comfortable doing.

Science Out of the Box can be used with any age group. Each activity is marked with the appropriate branch level (S, B, G, or P). Pathfinders can use this resource to plan a Leadership event for the Canada Cord. Rangers can choose to complete some of the more age-appropriate activities, or can lead any of the activities for younger girls. This is a guideline only. Some adaptations can be made so that the activity is more appropriate for other age groups.

Program connections are included at the end of each activity. For Sparks and Brownies, some of the hands-on activities will require assistance. We also suggest bringing in older girls to put on a science show to demonstrate more advanced activities. For Guides and Pathfinders, you will likely find that setting up stations works well. Appendix 2 contains a summary of the program connections.

Extensions for some activities have been included. If the girls are interested in a specific activity, there might be other activities to try on the same topic. For each section, background information is given first, then the activity description, extensions to the idea (in some cases), and program connections.

Remember that these activities can be substituted for the program work that is referenced in the program connections. In addition, you can substitute an activity in this resource for a related activity in the STEM challenges produced by the BC Program Committee.

We hope that this resource provides fun activities and useful information on science for both Guiders and girls. If you are not sure how to answer any of the girls' questions (or your own), please email the STEM Specialist c/o [program@bc-girlguides.org](mailto:program@bc-girlguides.org).

Additional science activities will be published in future editions of the FunFinder resource, which is available on the BC Girl Guides website. Also look for STEM-themed instant meetings and challenges on the BC Girl Guides website.

## **Safety in the Laboratory, Kitchen or Meeting Place**

Accidents can be prevented if you think about what you are doing at all times, use good judgment, observe safety rules and follow directions. Each activity includes safety precautions that alert you to potential hazards, including how to protect yourself and others against injury.

- Eye protection (safety glasses or goggles) must be worn when conducting some of the activities. Make a habit of putting them on before the activity begins and keeping them on until all clean up is finished.
- Do not eat or drink any substances while in the science laboratory.
- Do not taste anything, unless directed to by your Guider.
- Avoid wearing scarves, loose clothing, long necklaces and open-toed shoes.
- Long hair should be tied back so it will not catch on fire when working with open flames.
- Do not work alone; always work under the supervision of an adult.
- Never perform any unauthorized experiment without the permission of a Guider. Listen carefully to the instructions given by the Guider before beginning any activity or experiment.
- It is best to stand while doing experiments so that you can move back quickly in case of any spills or explosions.
- All equipment must be washed and cleaned before you put it away. Wipe all counter surfaces with soap and water. Always wash your hands thoroughly with soap and warm water after an experiment or an activity.
- Never point the open end of the containers that are being heated at yourself or another person.
- If you want to smell a substance, do not hold it directly to your nose. Instead, hold the container a few centimetres away and use your hand to fan vapours towards you. This is known as “wafting”. CAUTION: ammonia, which is used in the pH experiment, should never be inhaled!
- When diluting acids, always add the acid to the water. Never add water to acid. Make sure to add the acid slowly so the acid doesn’t splash.
- Flush with large quantities of water when disposing liquid chemicals or solutions down the sink.
- If an acid or a base comes into contact with any part of your body, wash the exposed area immediately and thoroughly with large amounts of cold water. If your skin becomes irritated, see a physician.
- If something gets into your eyes, flush them continuously for 15 minutes with water and inform your Guider.

## APPLIED SCIENCE

When scientific knowledge is used to develop practical solutions to problems, it is known as applied science. Engineering and healthcare are applied science fields.

### Engineering

The BC Program Committee has included applied science activities within the **STEM Challenge: Engineering**. See the challenge document for a list of activities.

### Healthcare

There are many fields of study in healthcare, and we cannot hope to cover them all in this document. One of the many fields is epidemiology, which is the study of the spread of diseases in groups of people – determining the cause of the diseases and helping with the plans to control them.

## Disease Detectives (G,P)

*This is an epidemiology activity, submitted by Jennifer May-Hadford, an epidemiologist and Guider in Kelowna, BC.*

### Directions

1. Read the scenario to the girls.
2. Show the map of the location.
3. Display the food and activities available at the event.
4. On large sheets of paper (so everyone can see), create the odds tables for each food and activity.
5. Hand out guest cards so that each girl has at least one guest card – you need to use all 24 guest cards. Have the girls interview each other and record the results. You can do this in front of the group, with two girls going up at a time – one as the interviewer and the other in character as the retreat guest, then switch roles, or you can do it so that the girls mingle with each other to collect the data, then return to record the information all together on the odds tables. Encourage the girls to get into character – make it fun, make up a funny story, act it up, but also make sure that each girl gives **correct information**. You must ensure that **every single guest is recorded on every odds table** – even if they did not eat the food or take part in the activity. For example, Jane is not sick and did not eat the broccoli & bacon salad, so you need to put a tick in the box **d** (bottom right) of the odds table for broccoli & bacon salad to take Jane's results into account.
6. After all interviews are complete, all of the odds ratio tables should be filled in (8 tables total). Calculate the Odds Ratio for each activity and food. Your results should be as follows (on the next page). Odds ratio table samples are included – you can print the included tables, or create your own on large paper for the whole group to see.

### Supplies

- ☐ printed map
- ☐ printed Food and Activities sheet
- ☐ printed guest cards
- ☐ paper and pencils for girls to record interview results
- ☐ large paper & marker (for odds tables) or printed odds tables
- ☐ calculator

| Food or Activity      | Odds Ratio |
|-----------------------|------------|
| Broccoli and Bacon    | 1.4        |
| Chicken Burger        | 0.8        |
| Fish Fillet           | 0.4        |
| Potato Salad          | 0.7        |
| Milk                  | 1.4        |
| Harvesting Vegetables | 0.7        |
| Swimming              | 0.2        |
| Farmyard              | 32.0       |

Odds Ratio Table

|                                  |     | Activity/Food |    |
|----------------------------------|-----|---------------|----|
|                                  |     | Yes           | No |
| illness<br>(diarrhea<br>& fever) | Yes | a             | b  |
|                                  | No  | c             | d  |

$$\text{Odds Ratio} = \frac{a \times d}{b \times c}$$

7. When the odds are much greater than 1, then the food or activity is considered to be associated with the illness. Here you can clearly see the farmyard has the greatest risk, but why?

Have the girls refer to the attached map to come up with reasons the farmyard could be the source of the illness.

What could the girls do next year to prevent a similar problem?

What could the retreat centre do to prevent other groups from having a similar issue?

How can we apply this information to Girl Guides and the practices we do?

### Solution

This issue is the fact there are no hand washing facilities after one plays with the farmyard animals.

The solutions the girls come up with should all have to do with encouraging hand washing or hand sanitizing. Removing the farmyard could also be an option.

You should also discuss the need to encourage hand washing when eating or preparing food.

### Program Connections

**Guides:** **Discovering You: Stay Fit and Healthy:** (6) Activity of choice.  
**Beyond You: Try New Things:** (6) Activity of choice.  
**Related Interest Badges:** Body Works (Alternate activity)  
**Pathfinders:** **Exploring a Theme:** Everything Comes from STEM (1), (3)

## Scenario

You attended an all girls Guiding retreat. What a lot of fun.....there was food, games and planned activities. Can you believe the latest gossip, the big star of your favourite TV show walked off the set because the wrong colour M&Ms were in her trailer! There were 24 of you there - good times!

Three days after the picnic thirteen girls were missing from your unit meeting – this is really unusual! You contact your best friend, as she is one of the missing ones. She tells you that she has diarrhea and a fever but she thinks she will be ok. You begin to wonder about the others – do they have the same problem?

You know that diarrhea can be caused by lots of things: eating food that has bad viruses or bacteria, being around people that are sick, swimming in contaminated water, not washing your hands after using the bathroom and handling animals without washing your hands afterwards.

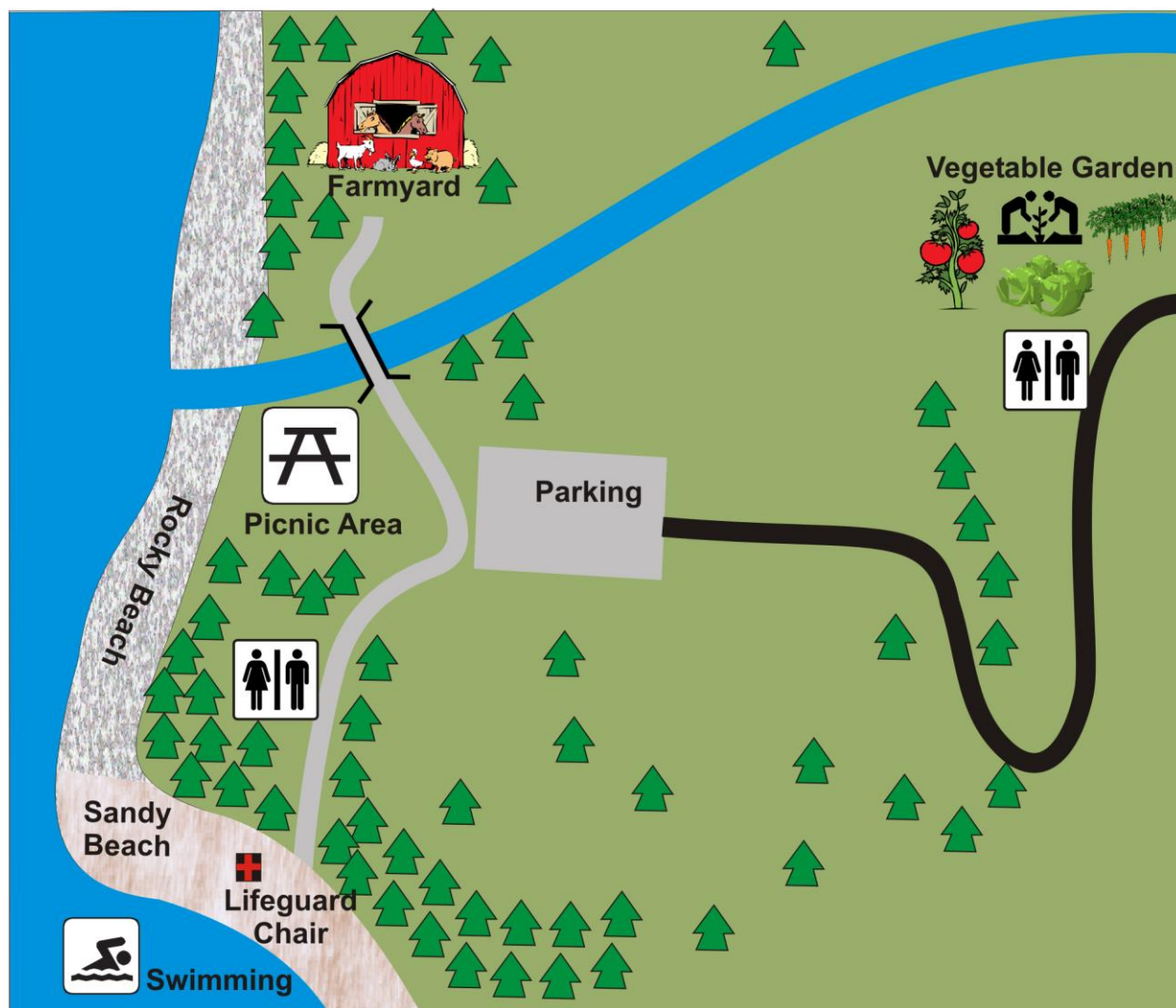
You start to think about what could have happened and remember the fun day at the retreat. You think back to all the things you did, ate and drank.

You come up with a plan: you will find out how many girls are sick and ask them what they did, ate and drank to see if there are any clues as to what went wrong.

But first you need to figure out what “sick” is: your friend indicated that she had diarrhea and fever. You know these are common symptoms of digestive illness, so you will use this as your CASE DEFINITION: diarrhea AND fever. They can have other symptoms, but they must have these two symptoms to be considered sick.

If they don’t have diarrhea and a fever we will not consider them sick for this exercise. Often when we question people about illnesses you will be surprised what people report, everybody has at least one symptom if you ask them!

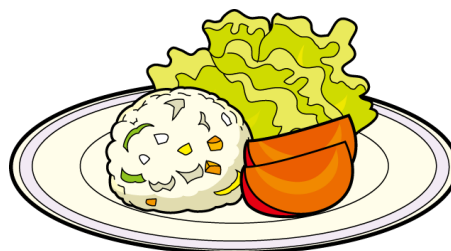
## Retreat Map



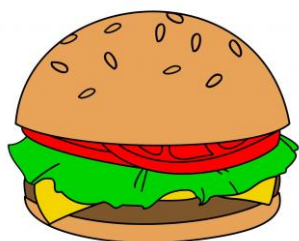
## Food and Activities at the Retreat



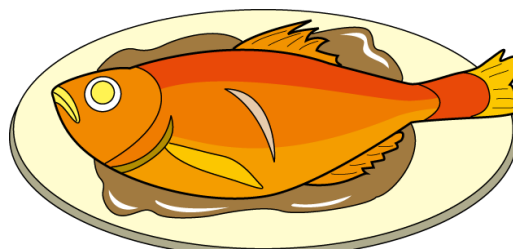
Broccoli and Bacon Salad



Potato Salad



Chicken Burger



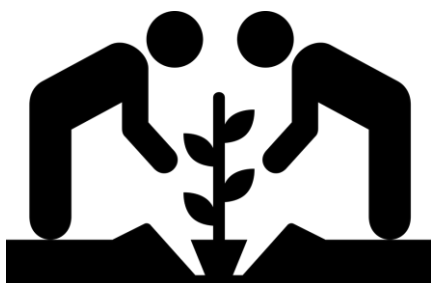
Fish Fillet



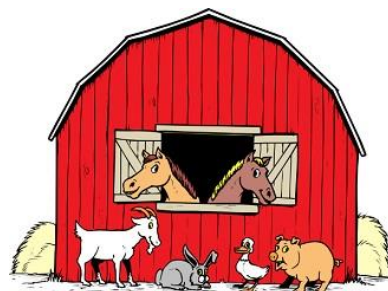
Milk



Swimming

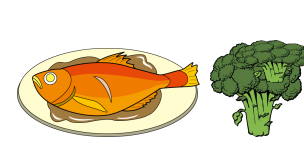
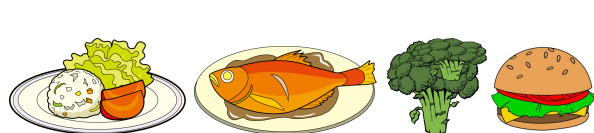
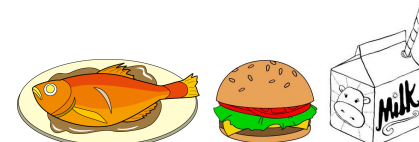


Harvesting Vegetables



Farmyard

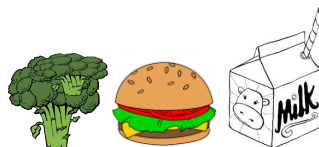
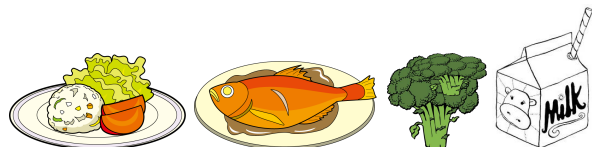
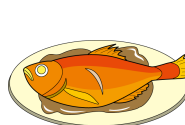
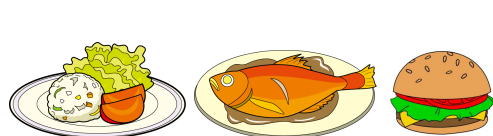
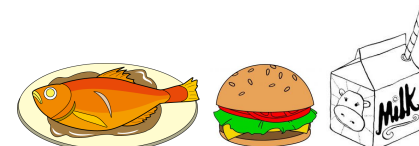
## Guest Cards

**Jane Smith****Symptoms:** headache, sore feet**Retreat food:****Retreat activities:****Jocelyn Hesse****Symptoms:** headache, sore throat**Retreat food:****Retreat activities:****Gemma Hicks****Symptoms:** sore eyes**Retreat food:****Retreat activities:****Sue Pasterick****Symptoms:** itchy scalp**Retreat food:****Retreat activities:****Gillian Frome****Symptoms:** sneezing, coughing**Retreat food:****Retreat activities:****Silvinia Sanchez****Symptoms:** itchy, watery eyes**Retreat food:**

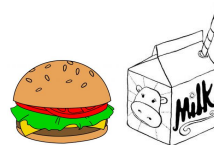
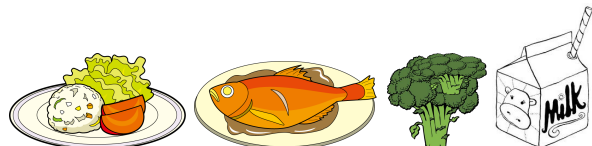
(didn't eat)

**Retreat activities:**

## Guest Cards continued

**Faith Tegere****Symptoms:** bumps on skin**Retreat food:****Retreat activities:****Shannon Matteric****Symptoms:** headache, sore feet**Retreat food:****Retreat activities:****Kimberly Walton****Symptoms:** headache, sore throat**Retreat food:****Retreat activities:****Annika Charles****Symptoms:** sore eyes**Retreat food:****Retreat activities:****Zoe Aiken****Symptoms:** itchy scalp**Retreat food:****Retreat activities:****Betty Broston****Symptoms:** diarrhea, fever**Retreat food:****Retreat activities:**

## Guest Cards continued

**Charlotte Matthews****Symptoms:** fever, sore stomach, diarrhea**Retreat food:****Retreat activities:****Davina Nelson****Symptoms:** fever, diarrhea, watery eyes**Retreat food:****Retreat activities:****Ella Oster****Symptoms:** diarrhea, stinky feet, fever**Retreat food:****Retreat activities:****Fern Pasternack****Symptoms:** fever, sore throat, diarrhea**Retreat food:****Retreat activities:****Giselle Reatty****Symptoms:** diarrhea, itchy scalp, fever**Retreat food:****Retreat activities:****Helen Swirk****Symptoms:** diarrhea, fever**Retreat food:****Retreat activities:**

## Guest Cards continued

**Isabelle Tertiac****Symptoms:** fever, sore stomach, diarrhea**Retreat food:****Retreat activities:****Jennifer Ursula****Symptoms:** fever, diarrhea, watery eyes**Retreat food:****Retreat activities:****Katherine Veral****Symptoms:** diarrhea, stinky feet, fever**Retreat food:****Retreat activities:****Laurissa West****Symptoms:** fever, sore throat, diarrhea**Retreat food:**

(didn't eat)

**Retreat activities:****Marnie Yip****Symptoms:** diarrhea, itchy scalp, fever**Retreat food:****Retreat activities:****Nellie Zhang****Symptoms:** runny eyes, diarrhea, fever**Retreat food:****Retreat activities:**

**Odds Ratio Tables**

Fill in these tables with the information the girls collect. You can either use the tables from this document, or create your own on large paper for the whole group to see.

If a guest was ill and ate the broccoli and bacon salad, place a tick in cell A (top left). If they were not ill but did eat the broccoli and bacon salad, place a tick in cell C (bottom left). Once you have gone through all 24 guests, sum up each cell and calculate the Odds Ratio for each of the foods and activities. Note: you should have 24 ticks in every table ( $a + b + c + d = 24$ ).

**Odds Ratio Table**

|                                               |     | <b>Activity/Food</b> |    |
|-----------------------------------------------|-----|----------------------|----|
|                                               |     | Yes                  | No |
| <b>illness<br/>(diarrhea<br/>&amp; fever)</b> | Yes | a                    | b  |
|                                               | No  | c                    | d  |

$$\text{Odds Ratio} = \frac{a \times d}{b \times c}$$

|                                               |     | <b>Broccoli &amp; Bacon Salad</b> |    |
|-----------------------------------------------|-----|-----------------------------------|----|
|                                               |     | Yes                               | No |
| <b>illness<br/>(diarrhea<br/>&amp; fever)</b> | Yes |                                   |    |
|                                               | No  |                                   |    |

Odds Ratio =

|                                               |     | <b>Potato Salad</b> |    |
|-----------------------------------------------|-----|---------------------|----|
|                                               |     | Yes                 | No |
| <b>illness<br/>(diarrhea<br/>&amp; fever)</b> | Yes |                     |    |
|                                               | No  |                     |    |

Odds Ratio =

|                                               |     | <b>Chicken Burger</b> |    |
|-----------------------------------------------|-----|-----------------------|----|
|                                               |     | Yes                   | No |
| <b>illness<br/>(diarrhea<br/>&amp; fever)</b> | Yes |                       |    |
|                                               | No  |                       |    |

Odds Ratio =

|                                               |     | <b>Fish Fillet</b> |    |
|-----------------------------------------------|-----|--------------------|----|
|                                               |     | Yes                | No |
| <b>illness<br/>(diarrhea<br/>&amp; fever)</b> | Yes |                    |    |
|                                               | No  |                    |    |

Odds Ratio =

|                                               |     | <b>Milk</b> |    |
|-----------------------------------------------|-----|-------------|----|
|                                               |     | Yes         | No |
| <b>illness<br/>(diarrhea<br/>&amp; fever)</b> | Yes |             |    |
|                                               | No  |             |    |

Odds Ratio =

|                                               |     | <b>Swimming</b> |    |
|-----------------------------------------------|-----|-----------------|----|
|                                               |     | Yes             | No |
| <b>illness<br/>(diarrhea<br/>&amp; fever)</b> | Yes |                 |    |
|                                               | No  |                 |    |

Odds Ratio =

|                                               |     | <b>Harvesting Vegetables</b> |    |
|-----------------------------------------------|-----|------------------------------|----|
|                                               |     | Yes                          | No |
| <b>illness<br/>(diarrhea<br/>&amp; fever)</b> | Yes |                              |    |
|                                               | No  |                              |    |

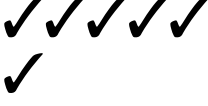
Odds Ratio =

|                                               |     | <b>Farmyard</b> |    |
|-----------------------------------------------|-----|-----------------|----|
|                                               |     | Yes             | No |
| <b>illness<br/>(diarrhea<br/>&amp; fever)</b> | Yes |                 |    |
|                                               | No  |                 |    |

Odds Ratio =

**Sample Odds Ratio Table and Calculation**

After interviewing all guests, here are the results for the broccoli and bacon salad.

|                                           |     | <b>Broccoli &amp; Bacon Salad</b>                                                                 |                                                                                                    |
|-------------------------------------------|-----|---------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------|
|                                           |     | Yes                                                                                               | No                                                                                                 |
| <b>illness<br/>(diarrhea &amp; fever)</b> | Yes | <br><b>a = 7</b> | <br><b>b = 6</b> |
|                                           | No  | <br><b>c = 5</b> | <br><b>d = 6</b> |

Check to make sure we have accounted for all guests:

$$a + b + c + d = 7 + 6 + 5 + 6 = 24$$

Yes, all cells in the table sum to 24, so all guest responses have been recorded.

Now calculate the odds ratio.

$$\text{Odds Ratio} = \frac{a \times d}{b \times c} = \frac{7 \times 6}{6 \times 5} = \frac{42}{30} = 1.4$$

Continue through all food and activities to calculate all odds ratios.

## BIOLOGY

Biology is the study of life and how organisms interact with one another and their environment. There are many categories in the study of biology. This section only includes a “taste” of the study of biology.

The BC Program Committee has produced resources that include activities related to biology: the **Ocean Aware challenge** includes marine life activities, and the **Eco Pak challenge** and the **Alien Invaders** challenge include ecological activities.

### Botany

Botany is the study of plants, or plant biology.

See the **Eco Pak challenge** Make a Tree activity, as well.

## How Does Water Climb a Tree? (S,B,G,P)

See also “Groundwater Pollution Experiment” in the *Eco Pak challenge*.

### Directions

1. Mix a teaspoon of food colouring into the water.
2. Cut the celery stalk about 2 cm from the bottom to expose a fresh end. Stand the stalk in the cup.
3. In one to two hours, the colour will spread up the stalk toward the leaves. Take the stalk out of the water.
4. Examine the cut end of the celery. What do you see?

### Supplies

- ☐ a tall glass, half filled with water
- ☐ red or blue food colouring
- ☐ a stalk of celery with some leaves on it; celery should be very fresh

### What’s Happening?

On the end of the celery you will see a tiny row of circles outlining the colour of the dye used. These fine tubes travel the length of the stalk. The coloured water travelled up the tubes by capillary action, which happens because of the high surface tension of water. These tubes spread out to the leaves, where water evaporates and pulls more water up through the tubes. With enough time, the colour will reach out to the tips of the leaves.

### Program Connections

**Sparks:** Exploring and Experimenting Keeper  
**Brownies:** Key to Living World: 2. Plant Life; Interest badge: Water, Water Everywhere  
**Guides:** Related Interest Badge: Plants and Animals (3)

## Human Biology

These activities teach concepts about how our bodies work, including information about our senses and how we get minerals in our food.

### Life Sized Body Map (S,B)

#### Directions

1. Cut lengths of paper about 15cm longer than each girl is tall.
2. In partners, have one girl lie on her paper while her partner traces around her body.
3. Switch partners so both girls will have their own body map.
4. Be creative and fill your body with its correct parts. You could use markers to draw in the various parts, or any other crafts supplies, such as cut up pieces of white paper to create the skeletal system (cut up Q-tips would make good finger or toe bones), different coloured construction paper cut to shape for various organs, plastic bags or bubble wrap or balloons for the lungs, streamers for intestines, red yarn for the circulatory system, etc.

#### Supplies

- ☐ roll of Kraft paper
- ☐ markers
- ☐ craft supplies, as necessary
- ☐ anatomy images – could be from the internet or library books

#### Program Connections

**Sparks:** Exploring and Experimenting Keeper

**Brownies:** Interest badge: Key to STEM Special Interest Badge

# Taste Test (S,B,G)

## Directions

1. Working in pairs, close your eyes and hold your nose while your partner feeds you a jellybean.
2. Keeping your nose pinched, try to guess the flavour of the jellybean.
3. Observations should proceed as you slowly chew the candy.
4. Is there any change in the taste of the candy from the beginning to the end of the experiment?
5. Describe the tastes.
6. Switch and let your partner try.

## Supplies

- ☐ jellybeans of different flavours

## What's Happening?

There are four different types of taste that are sensed on the tongue: sour, sweet, salty and bitter. About 80-90% of what we think of as “taste” actually is due to our sense of smell. Think how different food tastes when you have a stuffy nose. It is actually smell that lets us experience the complex, mouthwatering flavours we associate with our favourite foods.

## Program Connections

**Sparks:** Exploring and Experimenting Keeper  
**Brownies:** Interest badge: Key to STEM Special Interest Badge  
**Guides:** Related Interest Badge: Body Works (1)

# Using Your Nose (S,B,G)

See also "What's That Smell?" in the **CSI Challenge**.

## Directions

1. Work with a partner. Each girl takes three containers.
2. One partner closes her eyes while the other takes the lid off a container.
3. Holding the container near the girl's nose, gently fan the scent in the direction of the girl with closed eyes. See instructions on fanning odours in the Safety Section on page 3.
4. Guess what the scent is.
5. Replace the lid and repeat with the other two containers.
6. When all three containers have been tested, change positions and repeat the procedure for the second set of three containers.

## What's Happening?

The nose is so powerful that it can smell up to 10,000 different odours. Identifying smells is your brain's way of telling you about your environment and keeping you safe. When your brain sends a message based on a scent, it's because you've trained your brain to recognize a certain smell.

## Supplies

- ☐ container with ground cinnamon, labeled 1
- ☐ container with lemon juice, labeled 2
- ☐ container with garlic powder, labeled 3
- ☐ container with chocolate pieces, labeled 4
- ☐ container with mint (a mint tea bag works well), labeled 5
- ☐ container with dried oregano or basil, labeled 6

You can substitute any spice or food item with a strong smell that the girls are likely to be able to identify.

## Program Connections

**Sparks:** Exploring and Experimenting Keeper  
**Brownies:** Interest badge: Key to STEM Special Interest Badge  
**Guides:** Beyond You: Try New Things; 6. Activity of Choice  
 Related Interest Badge: Body Works: (1), Naturalist (5)

# Amazing Eye Tricks (B,G)

## Directions

1. Have the girls pick one of the picture sets to colour: the fish and bowl or the bird and cage. They must have both images in the set.
2. Cut out the two pictures and attach them back to back by taping the sides.
3. Push a straight pin sideways through the eraser of a pencil, so that the pin is perpendicular to the pencil.
4. Insert the pencil in between the two papers and secure them to the pencil with tape. The straight pin should be between the two pieces of paper, and will help to keep the pencil from rotating freely within the paper sandwich.
5. Hold the pencil upright between your two palms. Rub your palms back and forth to spin the image fast while staring at the pictures. What do you see?

## Supplies

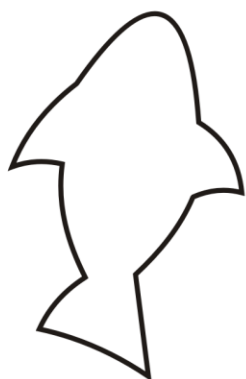
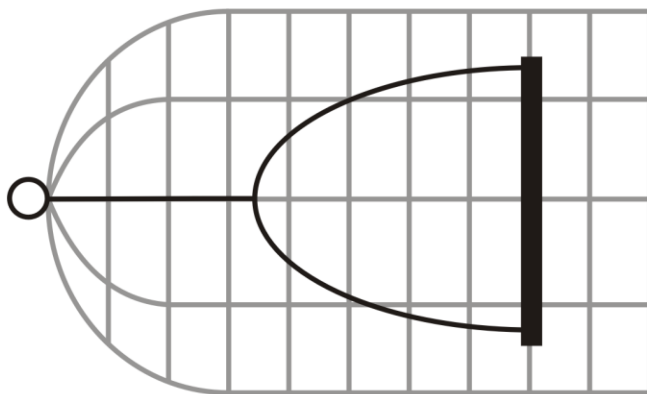
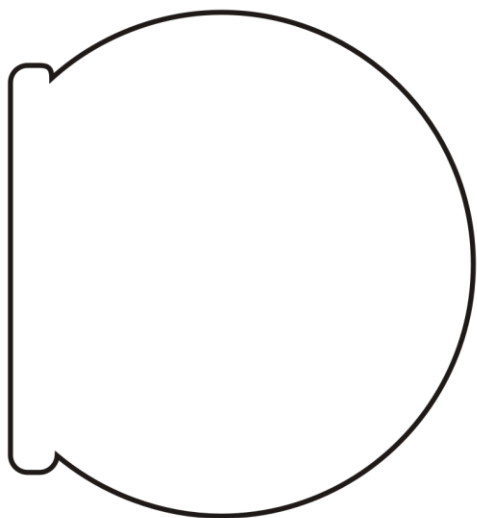
- ☐ copy of images on card stock
- ☐ pencils
- ☐ straight pin, large
- ☐ markers
- ☐ scissors
- ☐ clear tape

## What's Happening?

This is a processing phenomenon called the persistence of memory. The brain continues to see the first image for an instant after the paper turns to show the second image. When the image is rotated fast enough, the brain merges the two images so that the fish looks like it is inside the bowl or the bird looks like it is inside the cage.

## Program Connections

**Brownies:** Interest badge: Key to STEM Special Interest Badge  
**Guides:** Related Interest Badge: Body Works (5)



# Iron Fortified (S,B,G,P)

## Directions

1. Put Cheerios into a blender or a food processor and grind them up until they are very fine.
2. Add two tablespoons of finely ground Cheerios to a plastic cup.
3. Add 1 cup of water and mix well with a spoon.
4. Pick up the cup and hold a magnet (or two stacked together) onto the bottom of the cup while gently stirring. Do this for about 2 minutes, being careful to hold the magnet in the same spot on the bottom of the cup.
5. Without shaking the cup, remove the magnet and look for a small gray dot of iron in the place where the magnet was. You can move this dot around using the magnet to drag it.

## Supplies

- ☐ blender or food processor
- ☐ Cheerios
- ☐ water
- ☐ clear plastic cups
- ☐ 1 cup measure
- ☐ 1 tbsp measure
- ☐ spoons
- ☐ magnets (if using button magnets, stack two together); strong magnets work best

## What's Happening?

Fine iron particles are added to cereal in order to increase the iron content for the nutritional panel. Our bodies need iron so they can make healthy oxygen-carrying red blood cells. Iron is magnetic, so when you grind up the cereal, iron shavings are free to move around in the mixture and collect next to the magnet. And, believe it or not, our bodies are able to absorb small amounts of iron like this.

## Program Connections

**Sparks:** Exploring and Experimenting Keeper; Being Healthy Keeper  
**Brownies:** Key to STEM: 3. CABOOSH!; Key to Active Living: 3. Fabulous Food  
**Guides:** Beyond You: Try New Things: 6. Activity of Choice  
**Related Interest Badges:** Chemistry (6), Science (4)  
**Pathfinders:** Living Well: We Are What We Eat (2)  
**Exploring a Theme:** Everything Comes from STEM (1)

## CHEMISTRY

Chemistry is the study of chemicals. But what is a chemical, anyways? Some people will say that all chemicals are bad and dangerous, but in reality EVERYTHING in the whole world can be classified as a chemical: water, salt, sugar, air and even the components that make up your cells. So, it turns out we are all walking, talking blobs of chemicals!

In chemistry, there are two main areas to study: the physical properties of chemicals and how chemicals react.

The **STEM Challenge: Science** includes additional chemistry activities.

### Physical Chemistry

When we study how chemicals behave, we are learning about their physical nature. We start by understanding the most basic states of matter: gas, liquid, and solid. Investigating physical properties includes the structure and behaviour of the chemical, without changing the actual molecule being studied. For example, water is a liquid, but if you lower the temperature, it becomes a solid. Liquid water and solid water are the same compound – water! So this sort of study would be one on physical properties.

## Check out this Oobleck (S,B,G)

*Formerly called “Ack, It’s Gak” in Science in a Box.*

### Directions

1. (Optional) Add food colouring to the water in the bowl.
2. Add cornstarch to water in a bowl. Mix with your hands. Do not use a spoon.
3. When you touch the mixture gently, it should feel like a liquid and your fingers will sink in. When you smack your hand down on it, it should resist like a solid. Play away!

### Supplies

- ☐ ¼ cup cornstarch
- ☐ 3 ½ tsp water (add more if needed)
- ☐ a bowl
- ☐ food colouring (optional)

### What’s Happening?

Most substances exist on Earth as one of the three states of matter: solids, liquids or gases. But some substances are far more complicated! Oobleck is an example of this – it is not a solid, a liquid or gas! In fact, oobleck is a non-Newtonian fluid, which changes properties depending on the force you use. A large/strong force will give the oobleck the physical property of being solid; this is why when you smack the oobleck, it feels hard. But a small/weak force gives the oobleck the physical property of being liquid; this is why if you slowly, gently sink your hand in without force the fluid will feel like a liquid.

### Program Connections

**Sparks:** Exploring and Experimenting Keeper  
**Brownies:** Key to STEM: 3. CABOOSH!  
**Guides:** Beyond You: Try New Things: 6. Activity of Your Choice  
 Related Interest badges: Chemistry (8), Science (4)

# Freeze and Thaw! (S,B,G)

## Directions

1. Pour water into the cup and carefully place tape on the cup to mark the level of the water.
2. Place the cup in the freezer.
3. Predict what will happen to the water.
4. Once frozen, observe the level of the ice in the cup. Is it at the same level that the water was?
5. Leave the ice at room temperature and allow it to thaw. Where is the level of the water now?
6. Pour the water from the cup into a pot, cover with the lid and heat it until it boils. (Please have an adult help with this part.)
7. Predict what will happen to the water.
8. Take the lid off and see what happens. **CAUTION:** steam causes scalding – these burns are very damaging and painful.

## Supplies

- ☐ a cup
- ☐ water
- ☐ tape that won't come off in the freezer
- ☐ a pot with a lid
- ☐ access to a stove

## What's Happening?

We usually think of water in its liquid state, flowing from our taps. But water comes in two other states as well, depending on the temperature.

At 0°C and below, water freezes into its solid state, known as ice. In ice, the water molecules are trapped in an arrangement that gives microscopic holes in the solid. These holes are filled with air, which is all around us! So, when you freeze the water, you will find that the level of ice is actually higher than the liquid water level. This is because ice is not just solid water, but solid water with pockets of air trapped inside. As a result, ice is actually less dense than water and this is why ice floats in water. (Imagine a beach ball – when there is no air in it, it will sink. But if you fill it with air, it will float, just like the ice!)

Above 0°C, water is in its liquid state. As water is heated, it starts to evaporate and becomes a gas. Tiny, invisible droplets break off from the liquid surface and escape into the air. The warmer the temperature of the water, the faster the droplets break off and the more quickly the water evaporates. That's why rain puddles dry up faster on hot days. If the water temperature reaches 100°C, the water boils. In boiling water, the invisible droplets break off so quickly that they form bubbles in the water that rise to the top and release the gas vapour (steam) into the air.

## Extension: Popsicles

Make your own popsicles. Use your own recipe or find one online:

<https://www.google.ca/search?q=popsicle+recipe>

## Program Connections

**Sparks:** Exploring and Experimenting Keeper; In My Community Keeper  
**Brownies:** Interest badge: Water, Water Everywhere  
**Guides:** Related Interest badges: Physics (8), Science (5)

# Science in the Deep Freeze (B,G,P)

## Directions

1. Distribute a small baggie to each girl. Write each girl's name on her bag with a permanent marker.
2. Add 5 grams (1 tsp) of sugar.
3. Add 30 mL (2 tbsp) of milk and 30 mL (2 tbsp) of cream or 60 mL (4 tbsp) of half & half.
4. Add a dash of vanilla extract or about 2.5 mL ( $\frac{1}{2}$  tsp) of chocolate syrup.
5. Seal the small baggie then tape the top opening of the bag with duct tape to further seal it. Squish it around with your fingers to mix up the ingredients. Be careful not to break the bag.
6. Fill a large Ziploc-style bag half full of ice. Add about  $\frac{1}{2}$  cup of water. Add approximately 180 grams (12 tbsp) of salt to the large bag.
7. Working in teams of two or three, place the small, sealed bags of liquid mix into the large bag. Seal the large bag closed.
8. Carefully but vigorously, shake the bag for 10 minutes. Take turns with your partners. Be sure not to break the small bags inside. What do you notice about the mixture?
9. Remove the small bags from the large bag, rinse with cold water to make sure that the salt is off the bag, unseal the duct tape and pass out spoons. Enjoy!

## Supplies

- ☐ whole milk and cream or half & half
- ☐ vanilla extract or chocolate syrup
- ☐ sugar
- ☐ ice
- ☐ salt
- ☐ large Ziploc-style bags
- ☐ small Ziploc-style bags
- ☐ duct tape
- ☐ water
- ☐ measuring spoons
- ☐ 1 cup liquid measure
- ☐ spoons
- ☐ permanent marker

## What's Happening?

Pure water freezes at 0°C. However, salt water freezes at -10°C, which is cold enough to freeze the milk and sugar mixture. This is called a freezing-point depression. By placing the small bag into the salt water and ice, you are allowing the contents of the small bag to cool to the same temperature as the salt water and this will freeze the water in the milk. Vigorous shaking is needed to ensure that the ice particles on the mixture do not get too big. Without shaking, all you'd have is a frozen block of milk-ice, not delicious ice-cream! To ensure success, make certain that the ice in the outside bag does not melt before the ice cream freezes, and ensure that you have enough salt in the large bag to achieve the proper temperature. If one of the small bags breaks or leaks, you will end up with salty ice cream.

## Program Connections

**Brownies:** Interest Badges: Water, Water Everywhere; Team Together  
**Guides:** Related Interest Badges: Physics (8), Science (5), Tasty Treats (3)  
**Pathfinders:** Let's Take It Outside: Outdoor Know-How (2); Exploring a Theme: Everything Comes from STEM (1)

# Rescue the Ice Cube (S,B,G,P)

## Directions

1. Put an ice cube in a glass of cold water.
2. Put one end of a string on top of the ice cube and trail the rest over the side of the glass.
3. Try to pick up the ice cube with the string. Can you do it without touching the water with your fingers?
4. Now put one end of the string on the top of the ice cube and again trail the rest of the string over the side of the glass.
5. Sprinkle some salt on top of the ice cube and let it stand for 10 minutes without moving anything.
6. Try to pick up the ice cube with the string. Does it work this time?

## Supplies

- ☐ ice cubes
- ☐ several glasses of cold water
- ☐ several 20 cm lengths of string
- ☐ salt

## What's Happening?

Sprinkling salt crystals on top of the ice-cube causes areas of high salt concentration. The high concentration of salt mixes with the water on the surface of the ice cube and dissolves. This gives a salt-ice-water bath, which has a freezing point of  $-10^{\circ}\text{C}$ . This dip in temperature causes the remaining water on the surface of the ice cube to refreeze, since pure water freezes at only  $0^{\circ}\text{C}$ . When the water refreezes, it does so around the string. So when you lift the string, the ice cube is stuck to the string... rescue mission complete!

## Program Connections

**Sparks:** Exploring and Experimenting Keeper  
**Brownies:** Key to STEM: 3. CABOOSH!  
**Guides:** Related Interest Badges: Chemistry (8), Science (4)

# Slippery Stuff (S,B,G)

## Directions

1. Hold the palm of your hand at an angle under the tap and drip water onto your palm.
2. Watch what the water looks like as it runs across your palm. This is what you will compare all of the other parts of the experiment to.
3. Rub a few drops of soap on your hand.
4. Hold the palm of your hand under the tap and drip water onto your hand. Observe what happens. Rinse your hand clean and dry it before the next step.
5. Rub a few drops of cooking oil on your hand.
6. Hold the palm of your hand under the tap and drip water onto your hand. What happens? Is it different than what happened with the soap?
7. Wash your hands with soap and rinse your hands well. Does this remove all the oil from your hands?
8. Why do you think you should wash your hands with soap before you eat?
9. Try this experiment with other household items such as butter, vegetable shortening, pancake syrup, and juice to decide if these “chemical substances” are more like water or more like oil.

## Supplies

- ☐ oil
- ☐ soap
- ☐ water

## What's Happening?

The water molecules and oil molecules are VERY different, even though they are both liquids! Water is a very small molecule that is very attracted to other small water molecules because of its cohesive nature. Oil, on the other hand, is a very large molecule that sticks to other large oily molecules. Because water and oil are so different, they will not attract one another! Like molecules will mix with like molecules only! So when you try to remove the oil from your hand, the small water molecules do not attract the large oil molecules and take them with the flow into the sink. Instead, the oil molecules stay attracted to your hand, which contains other large oily molecules (like your sweat).

The soap molecules are friendly with both water and oil. This is because the soap molecules have 2 different parts, one that is long and oily that will stick to the oil molecules, and one that is small that will stick to the water molecules. So when there is soap only on your hand, the water grabs hold of the water end of the soap and takes the soap into the sink with the flow. When the oil is on your hand and you add soap, the oily part of the molecule grabs onto the oil molecules. Then when the water flows over the oil and soap latched together, the other end of the soap that attracts water send the whole mixture into the sink with the water flow. This lets the oil drops mix in with the water so that the oil can be washed off your hand.

So the soap molecules are just like you – you have two hands (ends) that can hold water in one hand, and oil in the other!

**Extension**

Demonstrate that oil and water do not mix. Pour some oil into a cup and add water. Observe that the oil will float to the top of the water.

See also “Oil Spill” in the **Eco Pak challenge**.

**Program Connections**

**Sparks:** Exploring and Experimenting Keeper; Being Healthy Keeper  
**Brownies:** Key to STEM: 3. CABOOSH!; Key to Active Living: 4. Germ Buster  
**Guides:** Discovering You: Stay Fit and Healthy: 6. Activity of choice  
Related Interest Badges: Chemistry (8), Science (4)

# Listen to the Lifeguard! (S,B,G)

## Directions

1. Make a list of safety rules for a visit to the pool. Tell the following story as you do this demonstration.
2. “One day a group of girls went swimming at the pool”, sprinkle pepper into the cup of water.
3. “The girls were very smart and knew all the rules at the pool, so when they heard the whistle, they knew just what to do!” – with a bit of soap on your finger, dip it into the middle of the cup.
4. “The lifeguard was able to save the day, without any girls in the way!”
5. “Next time you hear that whistle blow, now you’ll know where you need to go.”

## Supplies

- ☐ pepper (represents girls)
- ☐ a drop of soap on your finger (lifeguard)
- ☐ a cup of water (pool)

## What’s Happening?

Water molecules are very attracted to one another and stick tightly together causing a very high surface tension. The soap, which is only partly attracted to the water, breaks up this surface tension in the water causing a wave out from the soap drop. This wave carries the pepper to the edges of the cup.

## Program Connections

**Sparks:** Exploring and Experimenting Keeper; Going Camping Keeper  
**Brownies:** Key to STEM: 3. CABOOSH!; Key to I Can: 1. Staying Safe  
**Guides:** Beyond You: Try New Things: 6. Activity of Choice  
**Related Interest Badges:** Chemistry (8), Science (4)

# Touching the Tent (G,P)

## Directions

1. Pour the water into the cup, place the material on the top and put an elastic band around it to keep it taut.
2. Predict what will happen if you turn the cup upside-down.
3. Turn the cup over and make sure that it is directly upside down.
4. Touch the material underneath and watch the water leak through.
5. What do you think happens when you touch the side of your tent when it's raining?

## Supplies

- ☐ a piece of material (any type with a tight weave) large enough to cover the top of a cup
- ☐ a cup
- ☐ an elastic band
- ☐ water

## What's Happening?

Water molecules are very attracted to one another and stick tightly together causing a very high surface tension. The surface tension of the water acts like a skin next to the material. When you touch the material, the pressure and the oil on your fingers disrupt the surface tension and the water molecules start to leak through. Surface tension is what allows pond skaters (insects) to "walk" on water. This also demonstrates why you don't want anything touching the sides or the top of your tent when camping.

## Program Connections

**Guides:** **Related Interest Badges:** Basic Camper (5), Camp-out (6), Science (5), Physics (8)  
**Pathfinders:** **Let's Take It Outside:** Outdoor Know-How (1); **Exploring a Theme:** Everything Comes from STEM (1, 7)

# Make Metal Float (G,P)

## Directions

1. Pour water into a small plate.
2. Carefully try to slide the paper clip onto the surface of the water until it floats.
3. When the paper clip floats, look carefully at the surface of the water under the clip. Can you see the “skin” of the water that holds up the clip?
4. Put some soap on your finger and gently touch the surface of the water. What happens?

## Supplies

- ☐ a small plate
- ☐ water
- ☐ one paper clip
- ☐ soap
- ☐ compass (optional, for extension)

## What's Happening?

The water molecules are very attracted to each other because of the hydrogen bonding and stick together tightly causing a surface “film” which makes it harder for an object to move through the surface layer of the liquid than it is to move through the lower layers. Soap molecules, which are only partly attracted to the water, disturb the ability of the water molecules to “stick” together and this allows the clip to break through the surface and fall to the bottom. Once you introduce soap to the water, the paper clip cannot float on the surface of the water. To repeat the experiment, wash all the soap off the plate and start again with fresh water. Try floating other light metal objects across the plate, such as a staple or a sewing needle.

## Extension: Make a compass

*This extension activity also falls under the Physics: Electricity & Magnetism category.*

Use a needle instead of a paper clip. Prepare the needle by rubbing one end with wool in one direction for 2 minutes (i.e. pinch one end of the needle between your fingers, with the other hand, rub the wool from fingertips to the end of the needle and repeat.) Run the wool only in one direction. Float the needle on top of the water (pushing the needle through a small bit of foam material or wax paper will help) and the needle will try to turn to line up with the magnetic North Pole. Compare the direction of the needle with a compass. It should line up along with the north-south axis.

See <https://www.google.ca/search?q=homemade+compass> for alternate instructions.

## Program Connections

**Guides:** Related Interest Badges: Chemistry (8), Science (5)  
**Pathfinders:** Exploring a Theme: Everything Comes from STEM (1)  
Let's Take it Outside: Finding Your Way (Alternate activity)

# Clean It Up! (G,P)

See also “Oil Spill” in the **Eco Pak challenge**.

Oil spills are very damaging to the environment. Oil spills in the ocean often contain crude oil, which is like having tacky glue floating across the surface of the water. Imagine having to swim and eat in that water. Not all animals and plants will die as a result of the oil spill. This all depends on the size of the animal and its ability to escape the oil. Birds that have not touched the oil can fly away and animals that live on land and water can move away, but many animals cannot protect themselves from the effects of the oil.

## Fast Facts

- One teaspoon of oil in an Olympic size swimming pool can make all the water undrinkable.
- Oil spills hurt seabirds the most. When a bird's feathers get coated in oil, they can't keep warm, fly very well, or float on the water.

## Directions

1. Fill the container with water until it is half full. Pour a small amount of oil into the container.
2. Does the oil float or sink?
3. Imagine that you are a scientist and you have been asked to clean up the oil spill. What would you do? Use the materials supplied and figure out what works best to remove the oil.
4. After trying out the different methods, put a drop of soap into the container. What happens? Is this a good method?

## What's Happening?

In this particular investigation, adding soap makes it harder to remove the oil. The soap, which is partly attracted to the water and partly attracted to the oil, will cause the surface tension of the water to break, and the oil and water to mix better. If the oil and water are mixed more, they become nearly impossible to separate! Oil cleanup activities use absorbent, floating booms to surround the oil, then the oil is absorbed onto materials that can be picked up and removed to land for disposal. When you go to camp, remember to use biodegradable soaps, and to wash in designated areas.

## Supplies

- ☐ a large bowl or open-top container
- ☐ water
- ☐ gloves
- ☐ oil
- ☐ soap
- ☐ coffee filter
- ☐ sticks (coffee stirrers or craft sticks)
- ☐ pieces of string
- ☐ paper towel for cleanup

## Program Connections

**Guides:** **Beyond You: Learn About Our Environment;** 3. Water pollution, 6. Activity of choice

**Related Interest Badge:** Science (3, 6)

**Pathfinders:** **Exploring a Theme:** Everything Comes from STEM (1); Our Environment (alternate Activity); **Let's Take It Outside:** Outdoor Know-How (7)

# Rainbow M&M's (S,B,G)

See the *Rainbow Revelry Rainbow Appendix* for more rainbow science activities.

## Directions

1. Introduce the girls to Roy G. Biv – the acronym for the colours in a rainbow (Red-Orange-Yellow-Green-Blue-Indigo-Violet).
2. Flatten a coffee filter or paper towel on a table.
3. Place different coloured M&M's on the paper about 3 cm apart – arrange the colours according to the rainbow (Roy G. Biv: red-orange-yellow-green-blue – note: v=violet, but there are no violet M&M's).
4. Place a brown M&M separately on the coffee filter.
5. Drip water onto each M&M until the paper below is wet. Wait for about 2 minutes.
6. Pick up the M&M's and observe that the colours made a ring on the paper.
7. Compare the rings of the coloured M&M's to the ring under the brown M&M. Do you notice anything different about the outside edge of the brown ring?

## Supplies

- ☐ picture of a rainbow
- ☐ coffee filters or paper towels
- ☐ M&M's, multiple colours
- ☐ water

## What's Happening?

This activity demonstrates several principles:

- Colour theory shows mixing of primary colours to make secondary colours. For Sparks and Brownies, ask them to notice that the red, yellow and blue rings use primary colours and have only one colour ring. Then point out that the orange and green rings have a yellow ring in addition to the orange and green/blue, respectively. Finally, point out the brown M&M develops three distinct colour rings: red, yellow and blue.
- Chromatography is used to separate the dyes used to create the colours of the M&M's. For Guides and Pathfinders, point out that chromatography separates the inks used in the sugar coating (they are water soluble and dissolve with the sugar). The heaviest inks stay close to the center and the lightest inks move the farthest. By observing the colour(s) of the rings you can tell which ones are primary colours (use only one colour dye) and which are secondary (use two colours). Brown is a composite of red, yellow and blue. Over time, there will be three distinct colours seen around the brown M&M.
- Capillary action is the movement of water through small openings caused by the high surface tension of water. This explains why the water moved outward from the M&M's. The texture of the paper towel or coffee filter has many small channels (capillaries). The surface tension of water makes it climb up the sides of these capillaries and travel out from the centre of the M&M.

## Extension: Make this an experiment

Once you have learned about chromatography, turn this demonstration into an experiment by testing different types of coloured food products (jelly beans, Skittles, Kool-Aid, fruit juice crystals, etc.) or felt/ink markers to see if you can create different types of rainbows!

## Program Connections

**Sparks:** Exploring and Experimenting Keeper  
**Brownies:** Key to STEM: 3. CABOOSH!  
**Guides:** Related Interest  
**Badges:** Chemistry (4), Science (4)

## Reaction Chemistry

In chemistry, a reaction is when two or more molecules REACT with one another. At the molecular level, the different chemicals are rearranging to form brand new chemicals, but that's not something we can see with our human eyes. From the human point of view we can see the reaction take place through our senses. Did a colour change happen? Did we produce a solid or gas? Did it start to smell? Did the reaction get hot or cold, or even "explode"?! The possibilities are endless!

Chemical reactions have the following characteristics:

- A chemical change must occur. You start with one compound and turn it into another. One example of a chemical change is a steel garbage can rusting. Rust forms when the iron in the metal reacts with oxygen in the atmosphere.
- Reactions can happen with ions, molecules or pure atoms.
- Single reactions can happen as part of a larger series of reactions.

## Mix and Match (G,P)

This activity is similar to the **STEM Challenge: Science** activity "Cabbage Juice pH Indicator". The pH indicator can be used to replace the pH kit listed in the supply list for this experiment.

### Directions

1. Put your gloves and safety glasses on. Spread the paper towel on the tabletop.
2. Take the red lid off the pH tester.
3. Use the syringe to take some of the liquid out of one of the containers labeled ammonia, water, or vinegar and place it in the pH tester. Fill up to the MAX line.
4. Add 5 drops of the phenol red dye. Put the lid on tightly and shake it a bit.
5. The liquid will have changed colour. Match the colour and the number on the kit.
6. Now look on the pH scale to find out if the liquid is an acid or a base (alkaline).
7. Pour the used liquid into the waste cup.
8. Use clean water to rinse out the kit with the syringe.
9. Now repeat with the other two liquids.

### What's Happening?

A pH indicator is a special type of compound that changes according to the pH of the substance it reacts with. The phenol red dye that you have in your pH kit is a pH indicator.

### Supplies

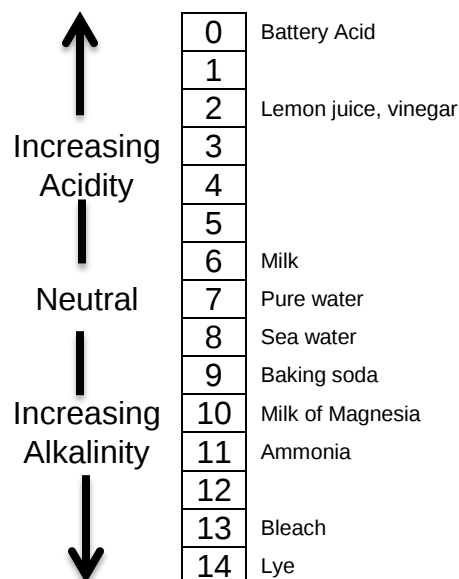
- ☐ pH kit
- ☐ vinegar, water and ammonia
- ☐ 1 cup for clean water
- ☐ 1 cup for the waste liquid
- ☐ plastic syringe
- ☐ paper towel
- ☐ safety glasses
- ☐ rubber or latex gloves

## Acids, Bases and pH

Acids and bases (also called alkaline) are on the opposite ends of a pH scale.

The pH scale shows how acidic or basic a substance is. The pH scale ranges from 0 to 14. A substance with a pH of 7 is neutral. A substance with a pH less than 7 is acidic, and a substance with a pH greater than 7 is basic.

Water is neutral. Vinegar and lemon juice are acidic substances, while laundry detergents and ammonia (found in glass cleaner) are basic. Chemicals that are very basic (e.g. lye, found in household drain cleaners) or very acidic (e.g. car battery acid) are called “reactive.” These chemicals can cause severe burns. Combining strong acids with strong bases is very dangerous.



## Extension

Test all kinds of different liquids. Start with the liquids you drink, such as pop, milk, and juice. Then take the pH kit on a hike and sample a creek, river, pond or puddles of water.

## Program Connections

**Guides:** **Beyond You: Try New Things:** 6. Activity of choice  
**Related Interest Badges:** Chemistry (8), Science (4)  
**Pathfinders:** **Exploring a Theme:** Everything Comes from STEM (1)

# What a Gooooooo-d Time! (S,B,G,P)

## Directions

1. Pour glue into a plastic cup. Add several drops of food colouring if you'd like. Stir with the popsicle stick to mix in the colour.
2. In a cup, slowly add the Borax to  $\frac{1}{4}$  cup of water. You want to keep adding Borax until it will no longer dissolve. If you have any excess solid floating around, you can filter it off with a coffee filter.
3. Slowly add the water-Borax solution to the glue, stirring with a popsicle stick. Keep adding until all of the glue is stuck to the stick in a big ball.
4. Using your hands, peel the goo off of the popsicle stick and squeeze out the excess water
5. Let the girls play with their goo!
6. To make the goo last longer, store in an air-tight Ziploc bag.

## Supplies

- ☐ Elmer's white school glue
- ☐ food colouring (optional)
- ☐ Borax laundry detergent
- ☐ water
- ☐ disposable plastic cups
- ☐ popsicle stick
- ☐ coffee filters (optional)
- ☐ Ziplock bag (optional)

## What's Happening?

Glue is a polymer. Polymers are long chain molecules that have many repeating units ("poly" means many!). The glue polymers also have areas that are available for bonding to ions such as the borate ion – which is found in Borax. The Borax connects one strand of glue polymer to another, causing the glue to not be able to flow as well, and be more solid, like Silly Putty!

## Program Connections

**Sparks:** Exploring and Experimenting Keeper  
**Brownies:** Key to STEM: 3. CABOOSH!  
**Guides:** Beyond You: Try New Things: 6. Activity of choice  
**Related Interest Badges:** Chemistry (1), Science (4)  
**Pathfinders:** Exploring a Theme: Everything Comes from STEM (1)

# Balloon Blowing (S,B,G,P)

This is a standard neutralization reaction.

## Directions

1. Place the empty pop bottle on the counter.
2. Use a funnel to pour  $\frac{1}{2}$  cup vinegar into the bottle.
3. Blow up a balloon and let the air back out. Do this several times to “relax” the balloon.
4. Put the other funnel into the mouth of the balloon and scoop  $\frac{1}{4}$  cup baking soda into the balloon. Allow the baking soda to settle into the bottom of the balloon.
5. Carefully stretch the open end of the balloon over the mouth of the bottle, being careful to leave the baking soda in the bottom of the balloon. Make sure the balloon is stretched to cover all the threads of the bottle.
6. Pick up the bottom, hanging end of the balloon and dump all of the baking soda into the bottle.
7. What happens?

## Supplies

- ☐ empty plastic pop bottle
- ☐ vinegar
- ☐ baking soda
- ☐ balloons
- ☐ 2 funnels
- ☐ measuring cups

## What's Happening?

The baking soda starts to fizz in the vinegar. A reaction occurs between the two chemicals and carbon dioxide is made. Carbon dioxide is a gas that takes up a lot more room than the solid and liquid, so it expands into the balloon.

## Program Connections

**Sparks:** Exploring and Experimenting Keeper  
**Brownies:** Key to STEM: 3. CABOOSH!  
**Guides:** Beyond You: Try New Things: 6. Activity of Choice  
 Related Interest Badges: Chemistry (2), Science (4)  
**Pathfinders:** Exploring a Theme: Everything Comes from STEM (1)

# Put Out That Candle (G,P)

## Directions

1. Make sure long hair is pulled back. See the Safety section on page 3.
2. Light the tea light candle.
3. Invert the glass and place it over the candle.
4. Observe the flame. What happens?

## Supplies

- ☐ tea light candle
- ☐ matches
- ☐ small glass with larger diameter than the tea light

## What's Happening?

Combustion involves a substance reacting with oxygen to produce heat. The wick of the candle is consumed using oxygen and heat to produce carbon dioxide and water. Once all of the oxygen is used up, the fire goes out. Remind the girls that fire needs four elements to burn: oxygen, heat (a spark), fuel and a chemical reaction.

There are four main ways to extinguish a fire: smother it (this removes oxygen), turn off the gas or remove other burnable materials (this removes fuel), douse with water (this removes the heat) or apply extinguishing agents, which inhibit the chemical reaction at the molecular level.

## Program Connections

**Guides:** **Beyond You: Try New Things:** 6. Activity of Choice  
**Related Interest Badge:** Fire Safety (2), Chemistry (8), Science (4)  
**Pathfinders:** **Exploring a Theme:** Everything Comes from STEM (2)  
**On My Own:** Prepare for the Unexpected (7)

# Poppin' Rockets (B,G)

## Directions

1. Begin by putting on your eye protection. See the Safety section on page 3.
2. Fill the plastic container about halfway with water.
3. Take a single square of toilet paper, or a tissue, and place it over the top of the container. Make a little “nest” with the paper inside the top of the container, but don’t push it too far down – it shouldn’t get wet.
4. Carefully place the antacid tablet into the toilet paper nest. It should not drop down into the water.
5. Snap the cover onto the container – the edges of the toilet paper will be sticking out from the sides of the lid.
6. Tear the excess toilet paper away and dispose.
7. Go outside to launch your rocket, as this can be messy! Flip your rocket upside down, so that the lid is on the bottom. Place the rocket on your launch pad (sidewalk, driveway, etc.) and move away.
8. Stand back and wait. Your rocket will blast off!

## Supplies

- ☐ small plastic container, similar to a 35 mm film canister or pill bottle; do not use threaded or childproof caps
- ☐ water
- ☐ effervescent (fizzing) antacid tablet (the kind used to settle an upset stomach)
- ☐ toilet paper or tissue
- ☐ safety glasses

## What's Happening?

When the water meets the antacid tablet, the tablet dissolves and creates a gas called carbon dioxide. As more gas is created, pressure builds up until the small canister can no longer contain the gas. The lid pops off, the gas escapes, and the canister shoots up.

## Program Connections

**Brownies:** Key to STEM: 3. CABOOSH!  
**Guides:** Beyond You: Try New Things: 6. Activity of Choice  
Related Interest Badges: Chemistry (2), Science (4)

# Elephant Toothpaste (B,G,P)

## Directions

NOTE: we recommend you do this experiment in a washable, deep tray, as foam will overflow from the bottle.

1. In a small cup, combine the warm water and the yeast together and stir for about 30 seconds. Set aside.
2. Ask an adult to carefully pour the hydrogen peroxide into the pop bottle. Warning: Hydrogen peroxide can irritate skin and eyes, use with caution.
3. Add about 8 drops of food colouring into the bottle.
4. Add 1 tbsp of liquid dish soap into the bottle. Shake the bottle carefully side to side to mix the soap, food colouring, and hydrogen peroxide together.
5. Now you're ready to make toothpaste! Pour the yeast water mixture into the bottle (a funnel helps here) and watch the foamy fountain erupt! The foam is totally safe to touch at this point. Read below to find out why.

## Supplies

- ☐ a clean 591 mL plastic pop or water bottle
- ☐ ½ cup 20-volume hydrogen peroxide liquid (20-volume is a 6% solution, get this from a beauty supply store or hair salon)
- ☐ 1 tbsp (one packet) of dry yeast
- ☐ 3 tbsp of warm water
- ☐ liquid dish soap
- ☐ food colouring
- ☐ small cup
- ☐ large, deep, tinfoil tray

## What's Happening?

Did you notice the bottle and foam was warm? This is because you created an exothermic reaction, which means you not only made foam but also heat! The yeast acted as a catalyst to remove the oxygen from the hydrogen peroxide. Because the yeast worked so fast, it created lots of bubbles. All the small bubbles that make up the foam are filled with oxygen. The foam you see is just water, soap, and oxygen so you can touch it with your hands, clean it up with sponges, and pour any extra liquid in the bottle down the drain.

## Program Connections

**Brownies:** Key to STEM: 3. CABOOSH!  
**Guides:** Beyond You: Try New Things: 6. Activity of Choice  
 Related Interest Badges: Chemistry (2), Science (4)  
**Pathfinders:** Exploring a Theme: Everything Comes from STEM (1)

# Vitamin Packed (S,B,G,P)

Chemical reactions can be endothermic or exothermic. This experiment is an example of an endothermic reaction, which means that it draws heat from the environment. The materials get colder as the reaction proceeds. It occurs at room temperature, so it is safe for the girls to do it themselves.

## Directions

1. Grind up two vitamin C tablets with the mortar and pestle. Alternatively, use a spice grinder to obtain a fine powder.
2. Place the vitamin C powder from two tablets into a clear plastic cup (about 1 tsp).
3. Add  $\frac{1}{4}$  cup of water.
4. Mix the powder to dissolve in the water. Place the thermometer into the liquid.
5. Make note of the reading on the thermometer. When the thermometer reading becomes constant, write down the numbers as the initial temperature.
6. Measure 1 tsp baking soda and add to the liquid. Gently stir the mixture with the thermometer.
7. Watch the readings on the thermometer. What happens?
8. When the thermometer reading becomes constant, write down the temperature as the final temperature.
9. What happened to the temperature when you compare the initial temperature to the final temperature? Did everyone see the same thing happen?

## What's Happening?

Vitamin C tablets are made primarily of ascorbic acid,  $C_6H_8O_6$ . In this activity, we dissolved the powder in water. The sodium bicarbonate (also known as baking soda) is a base. When an acid is mixed with a base, a neutralization reaction occurs. Here water, carbon dioxide and a salt are formed. In this particular case, sodium ascorbate is produced.

This reaction demonstrates that not all chemical reactions produce heat. Some chemical reactions are endothermic, where heat is absorbed and there is a drop in temperature. Some chemical reactions require heat to make them start. However, when you have to heat chemicals to provide the initial temperature or require heat input to make the reaction go, these demonstrations tend to be less safe for girls to carry out.

Note that the water added is used to dissolve the powders and is only there to help the two reactants (ascorbic acid and sodium bicarbonate) come into contact with each other. Although finely ground, the mixed powders cannot come into close enough contact to react with other without the water. The amount of water at the end of the reaction will be the original amount of water added to make the solution, plus the amount of water made by the reaction.

## Supplies

- ☐ clear, plastic cup, about 5 cm diameter bottom, 1 per group
- ☐ kitchen thermometers, 1 per group
- ☐ vitamin C tablets, 2 per group
- ☐ mortar and pestle or coffee/spice grinder
- ☐ baking soda, 1 tsp per group
- ☐ measuring spoons
- ☐ measuring cups
- ☐ water
- ☐ paper
- ☐ pencils

## Program Connections

**Sparks:** Exploring and Experimenting Keeper

**Brownies:** Key to STEM:

3. CABOOSH!

**Guides:** Beyond You: Try New Things: 6. Activity of Choice

**Related Interest Badges:** Chemistry (2), Science (4)

**Pathfinders:** Exploring a Theme: Everything Comes from STEM (1)

**Living Well:** We Are What We Eat (2)

## COMPUTER SCIENCE

Computer science is the study of computers and computing. It includes both the hardware of computers (the physical equipment) and the software used within the equipment. The **STEM Challenge: Technology** includes both hardware and software related activities.

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### Computer Hardware

Computer hardware is the physical components of a computer system.

The BC Program Committee has included computer hardware activities within other published resources. Some examples are as follows:

See also the following activities in the **STEM Challenge: Technology**

- Be a Computer!
  - Build a Computer (for Junior Techies)
  - Computer Jeopardy
  - Computer Parts Word Search
  - Squeaky Clean
  - Computer Concentration
  - Dissect a Cell Phone
- 

### Computer Software

Computer software is a set of computer-readable instructions that direct a computer system to perform operations.

The BC Program Committee has included computer software activities within other published resources. Some examples are as follows:

See the following activities in the **STEM Challenge: Technology**

- Computer Programming
  - Write a Program from Scratch
  - Robot Pin the Tail on the Donkey
  - Training Your Robot
  - Robbie the Robot
-

## EARTH SCIENCE

There are four Earth Science categories:

1. **Geology** is the study of the rocks and processes that form planet Earth.
2. **Meteorology** is the study of the atmosphere and the processes that form the Earth's weather and climate.
3. **Oceanography** is the study of the Earth's oceans.
4. **Astronomy** is the study of the universe.

### Geology

The BC Program Committee has included geology activities within other published resources. Some examples are as follows:

#### Eco Pak challenge:

- The Great Cookie Extraction
- Edible Earth Parfait
- Natural Resource Fieldtrip
- Explore the Earth

#### Ocean Aware challenge:

- Erode the Sugar Cube
- Erosion Target Practice
- Sea Level Change
- Erosion Tag
- Shape the Earth
- Erosion Cycle Race
- Beach Sundae

## Rock On (S,B)



*This activity has been provided by the Association of Professional Engineers and Geoscientists of BC (APEGBC).*

Rocks come in different shapes and sizes. You must have seen rocks in many places – at the playground, at the beach and maybe in your backyard. There are three main categories that we can divide all rocks into. The three types of rocks are sedimentary rock, metamorphic rock and igneous rock. Speaking of rocks, what better way can there be to learn about them through a fun game of Rock On!

### Directions

This game is best played in a gym or large field, this activity will allow for girls to burn off some steam while learning about different rock types.

1. Talk to the girls about the different types of rocks and how each one is formed. (Please see below for a more detailed description of the three rock types).
2. Review the rock cycle to follow for this game (for example: sedimentary to metamorphic to igneous back to sedimentary would mean that sedimentary beats igneous, metamorphic beats sedimentary and igneous beats metamorphic).
3. You then review different actions and phrases for each rock type. You can come up with your own examples or use the ones provided below.

|                                                                                                                       |                                                                                                              |                                                                                                                                                    |
|-----------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Sedimentary Rock</b><br><b>Action:</b> Layer arms one on top of the other<br><b>Phrase:</b> "Sedimentary, m'dear!" | <b>Metamorphic Rock</b><br><b>Action:</b> Push palms together.<br><b>Phrase:</b> "It's getting' hot in here" | <b>Igneous Rock</b><br><b>Action:</b> Jump up and move arms to mimic a volcanic eruption.<br><b>Phrase:</b> "Iggy, Iggy, Iggy, rockin' everywhere" |
|-----------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------|

4. Split into two teams. Both teams line up across each other.
5. Each team takes a moment to discuss which rock type their group will be transforming into.
6. Wait for the Guider to shout 'Rock On!' At this signal, teams act out their rock type.
7. The winning team calls over one member from the other team to join their team.
8. Repeat steps 4-7 until desired end of game.

**Got more time? Here are some variations:**

- Come up with more cool actions and phrases for each rock type.
- Try playing the game in pairs of two – best out of 5 wins!
- Pass around samples of rocks when discussing characteristics, as available.
- Try thinking of other things that geoscientists find under the earth and include them in your game.

**What's happening?**

Your group is learning more about the rock cycle. This includes how rocks are formed and how over time they may become different types of rocks.

Sedimentary rock is formed when rocks, minerals or other materials are moved and left in a new location. Over time, many layers are squeezed together to become a new rock.

Metamorphic rock is made when rocks are changed over time through heat and pressure.

Igneous rock is formed when magma (or lava) cools and then solidifies (or hardens). This can happen below or above the surface of the earth, like when a volcano erupts.

You decided on the lifecycle that your rock went through to determine which rock beats which. This means that rocks change from one type to another depending on the environment they are exposed to.

**Program Connections**

**Sparks:** Exploring and Experimenting Keeper  
**Brownies:** Interest badge: Key to STEM Special Interest Badge

# Colourful Convection (G,P)

*This activity has been provided by the Association of Professional Engineers and Geoscientists of BC (APEGBC).*

Density is highly dependent on temperature. Less dense materials tend to rise while denser materials usually sink. Convection is the movement within liquids referring to the sinking of colder, denser material and rising of hotter, less dense material under the influence of gravity, resulting in a transfer of heat. Convection currents are formed in the air as well, when warm and cold air meet. This activity showcases convection currents in a colourful way.

## Directions

This activity can be done as a group, in pairs or individually. This activity is best performed outside, in a sink or another easy-to-clean platform.

1. Fill two bottles with warm water from the tap and the other two bottles with cold water. Use food colouring to colour the cold water one colour, and the warm water the other colour. Make sure to fill both bottles to the top.
2. Place the index card or playing card over the mouth of one of the warm bottles. Hold the card in place as you turn the bottle upside down and rest it on top of one of the cold water bottles. Be careful when positioning them mouth over mouth with just the card separating the two bottles.
3. Here comes the tricky party: slip the card out from in between the two bottles, still holding onto the top bottle tightly. Have your partner(s) help you by holding on to the bottle(s).
4. Observe what happens to the coloured liquids.
5. Repeat steps 2-4, but place the cold water bottle on top this time. Observe what happens.

## What's happening?

Just as warm air is lighter than colder air, warm water is lighter than cold water. In other words, warmer materials are less dense. When you placed the warm water bottle on top of the cold water one, they both stayed in place. Warm water stayed on top and the colder water rested on the bottom. However, when the cold water was placed on top of the warm water bottle, the colder water sunk to the bottom and the warm water rose. This movement of warm and cold water inside the bottles is referred to as convection currents.

When heat from the Earth's core is transferred upwards to the surface this process is called mantle convection. Scientists believe that heating of the mantle by the earth's core creates convection cells in which hot mantle material rises, cooling as it goes, toward the crust until it reaches less dense material. At this point the hot mantle material spreads out then descends. Mantle convection is assumed to be responsible for plate tectonics and continental drift as well as volcanism.

For more information check out this website: <http://www.wisegeek.com/what-is-mantle-convection.htm>



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## Supplies

- ☐ 4 identical empty plastic pop bottles
- ☐ warm and cold water
- ☐ food colouring (2 colours)
- ☐ index card, or an old playing card

## Program Connections

**Guides:** Beyond You:

**Learn About Our**

**Environment:** 6. Activity of choice

**Related Interest Badges:**

Water (Alternate activity),  
Science (Alternate activity)

**Pathfinders:** Exploring a  
**Theme:** Everything Comes  
from STEM (1)

**Exploring a Theme:** It's  
About Time (4)

# Form a Fossil (S,B,G,P)

*This activity has been provided by the Association of Professional Engineers and Geoscientists of BC (APEGBC).*

Think about it: If dinosaurs went extinct so many years before humans, how do we know they ever existed? Well, the answer is – fossils! A fossil is evidence of past life preserved in sediment or rocks. Fossils take many years to form and are developed naturally. Layers of organic material pile onto sea floors, muddy swamps and land areas and are trapped for long periods of time. They cannot rot due to the lack of air, so they are constantly pushed down on with pressure. Slowly and gradually, the pressure results in the creation of a fossil. However, why sit and wait for a fossil when you can make one?

## Directions

This activity can be done as a group, in pairs or individually. As it requires time for “fossilization”, this activity is best done at camp.

1. Place a paper towel, three to four gummy fish and three slices of bread on a table.
2. Carefully remove the crust from the bread slices.
3. The white bread represents the sandy ocean floor. Put this slice on top of the paper towel and a gummy fish on the bread to represent dead marine life.
4. Now put a piece of rye bread on top of the white bread layer. This represents the way ocean currents deposit sediments on top of dead life.
5. Now add the remaining gummy candy, then the last slice of bread. Natural processes have taken place over millions of years – fast forward all the sand and sediments that have been deposited by ocean and wind currents.
6. Fold the paper towel to cover the entire stack.
7. Now we need pressure to help the marine life fossilize. Place heavy textbooks on top of the bread to simulate the natural process of pressure.
8. Leave the bread for one to two days. This represents the passage of millions of years.
9. Coming back later, put a straw through the stack to extract and analyze your findings.

## What's happening?

Over time, fossils are formed in places such as our ocean floors where animal remains collect under rocks and debris. The intense pressure results in the formation of an imprint over long periods of times.

For more information check out this website: <http://www.earthsciweek.org/classroom-activities/fossil-formation>.



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## Supplies

- ☐ paper towels
- ☐ 3 slices of bread (one of each: white, wheat, and rye – or mark to differentiate)
- ☐ gummy candy fish (or other gummy sea animals or plants)
- ☐ heavy books
- ☐ magnifying lens
- ☐ clear drinking straws

## Program Connections

**Sparks:** Exploring and Experimenting Keeper

**Brownies:** Key to the Living World: Additional Activity; Interest badge: Key to STEM Special Interest Badge

**Guides:** Beyond You: Learn About Our

**Environment:** 6. Activity of choice

**Related Interest Badges:** Science (Alternate activity), Plants and Animals (Alternate activity)

**Pathfinders:** Exploring a Theme: Everything Comes from STEM (1)

**Exploring a Theme:** It's About Time (4)

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## Meteorology

The BC Program Committee has included meteorology activities within other published resources. Some examples are as follows:

### Eco Pak challenge:

- Environment Jeopardy

### Ocean Aware challenge:

- Rain in a Jar
- Parachute Water Cycle
- Water Cycle Shakeout
- Ocean Circulation
- Current in a Bag
- Mini Ocean Currents
- Current Chain Game
- Water Holds Heat
- Freeze Tag
- Hurricane in a Jar
- Hurricane Spins Game

### Rainbow Revelry – Blue resource:

- Shaving Cream Rain

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## Oceanography

The BC Program Committee has included oceanography activities within the **Ocean Aware challenge**. See the challenge document for a list of activities.

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## Astronomy

Astronomy is a field of science concerned with studying the universe outside of the Earth's atmosphere. The positions, distributions, motion and composition of celestial bodies are studied.

The BC Program Committee has included astronomy activities within other published resources.

See the following activities in the **WOWZA Toolkit**:

- Sun Plate
- Personal Constellations
- Flying Comets
- Revolve, Rotate

## Finding Stars (B,G)

*This game is provided courtesy of NASA at <http://spaceplace.nasa.gov/starfinder/en/>.*

It is best to schedule this activity during the winter months when the sun sets earlier. Visit the NASA Space Place website to download the Star Finder templates, and to find additional astronomy activities.

### Directions

1. Cut the edges of the printed Star Finder to make a square.
2. Fold the paper according to the folding instructions found online. The Star Finder is folded similar to a “cootie catcher” or “origami fortune teller”.

### Activity Instructions

1. Stick your thumbs and first two fingers into the four pockets on the bottom of the Star Finder.
2. Ask another girl to choose one of the top four squares. Depending on the number on the square chosen, open and close the Star Finder that many times (open up and down, close, open side to side, close, etc.).
3. Ask your partner to look inside the Star Finder and pick one of the four visible constellations. This time open and close the Star Finder once for each letter to spell out the constellation name.
4. Ask your partner to pick one of the four constellations visible now. Open this panel to see the name of a constellation that you will try to find in the night sky for this month.
5. Repeat steps 1-5 so that the partner also gets the name of a constellation to find.
6. Go outside and look for your constellation in the night sky.

### What's Happening?

The Star Finder shows the relative position of the stars in the night sky for the month indicated. Although the stars are actually moving in space, they are so far away from us that we are not able to detect the change in position. As the Earth travels along its orbit, different sets of stars are visible in the night sky.

### Supplies

- ☐ printouts of the Star Finder for the correct month, found at <http://spaceplace.nasa.gov/starfinder/en/>
- ☐ scissors
- ☐ binoculars
- ☐ blankets or tarp to lie upon when outside

### Program Connections

**Brownies:** Key to STEM:

6. Reach for the Stars!;

**Interest badge:** Exploring Space

**Guides:** Related Interest Badge: Astronomy (4, 6)

# Creating Constellations (S,B,G)

## Directions

1. Set your flashlight, lamp end down, on a black piece of construction paper, and trace around the flashlight circle onto the paper.
2. Cut out the circle.
3. Take a constellation picture and place it down on the black circle.
4. Using a pushpin, poke holes through the stars on the constellation making sure that it also goes through the black construction paper. These holes need to be the full size of the pushpin, not just the pin point. Or you can use something bigger like a pen tip to enlarge the holes
5. Tape the construction paper onto the end of the flashlight making sure not to cover any of the holes.
6. Turn out the lights and shine the flashlight onto a clear wall. Girls need to stand only about 10 - 20 cm from the wall to get a clear image. Try to identify the constellations.

## Supplies

- ☐ printouts of the constellations
- ☐ black construction paper
- ☐ pencils
- ☐ pushpins (with the plastic tops)
- ☐ scissors
- ☐ flashlights with the lamp end at least 2 cm in diameter.
- ☐ tape

## What's Happening?

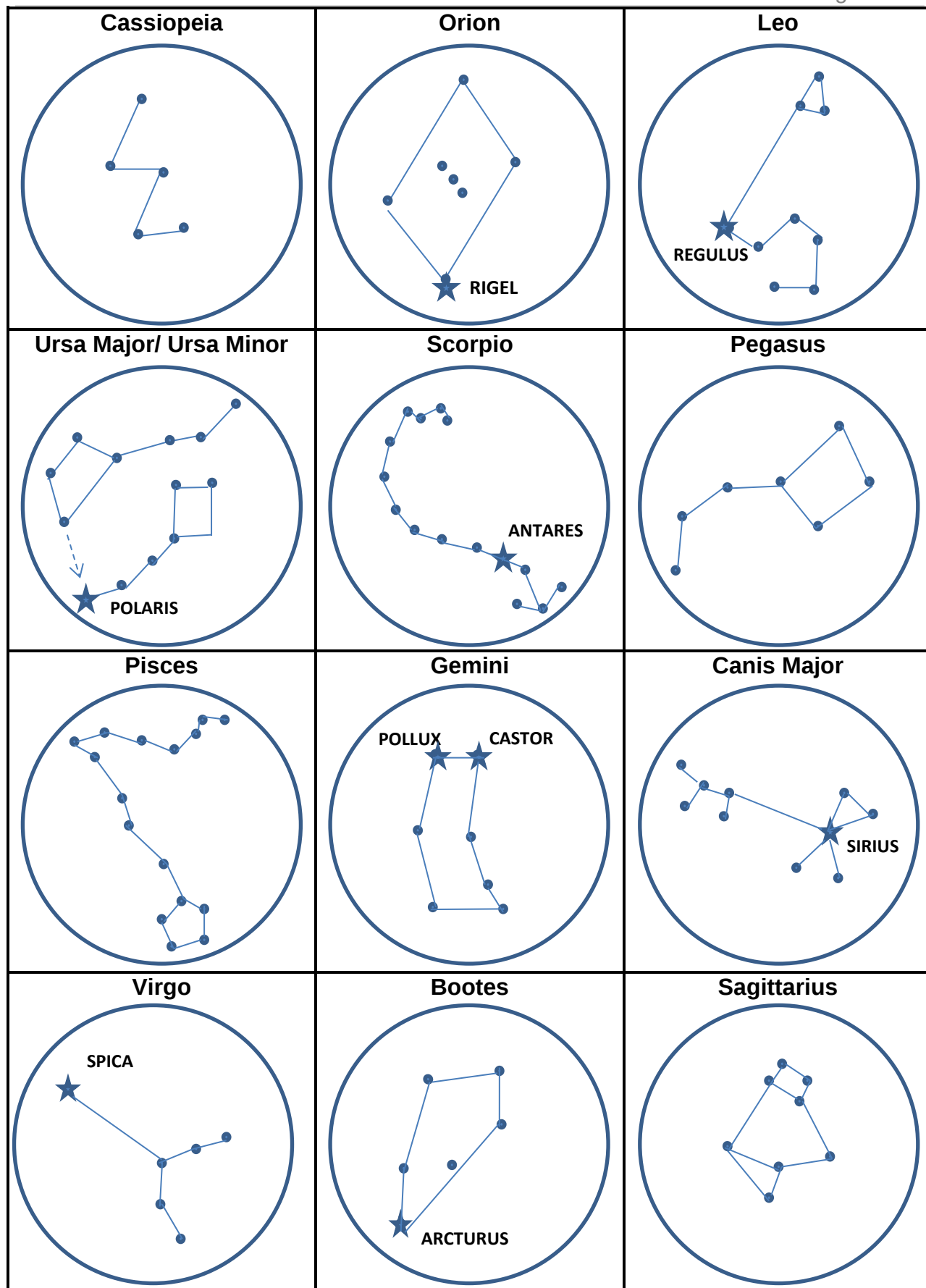
The holes in the construction paper allow the light to shine through, creating the pattern of the constellation used as a model.

## Extension

Girls can create their own constellation.

## Program Connections

**Sparks:** Exploring and Experimenting Keeper  
**Brownies:** Key to STEM: 6. Reach for the Stars!; **Interest badge:** Exploring Space  
**Guides:** Related Interest Badge: Astronomy (4, 6)



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## ENVIRONMENTAL SCIENCE

Environmental science is the study of the interactions and effects of natural and unnatural processes on the environment and organisms.

The BC Program Committee has included environmental science activities within other published resources. See the **Eco Pak challenge**, the **Ocean Aware challenge**, and the **Alien Invaders challenge** for related activities.

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## FORENSIC SCIENCE

Forensic science is the practical application of science (including biology, physics, chemistry and other scientific principals) to gather information about physical evidence, which can be used to help solve crimes.

The BC Program Committee has included forensic science activities within the **CSI challenge**. See the challenge document for related activities.

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## PHYSICS

Physics focuses on the properties of matter and energy. It investigates topics such as light, sound, magnetism, electricity, force, motion, and mechanics.

### Light and Sound

Light and sound are similar in that they are both forms of energy that move in waves. Visible light is a small portion of the range of electromagnetic radiation. Our eyes are “tuned” to see the waves in this specific range and our brains interpret these electromagnetic waves as visual information. Sound is the frequency of vibrations that our ears can hear.

The BC Program Committee has included sound activities within other published resources.

See the following activities in the **WOWZA Toolkit**:

- Chicken Sounds
- Balloon Conductor
- Vuvuzela Balloon
- Sound Sandwich
- Water Whistle
- Sound Waves on an Eardrum
- Echolocation Demonstration
- Echolocation Game
- Tick Tock Trick / Make a Stethoscope

## Flashes of Light (G,P)

### Directions

1. Turn out the lights so that the room is very dark. Often bathrooms will work well for this.
2. Keep the glass of water handy in case you choke on the candy.
3. Wait about 15 – 20 minutes in the darkened room until you can see your teeth in the mirror. Make certain that your eyes have adjusted to the dark environment.
4. With your lips open so that you can see your teeth, chew a single Lifesaver candy while watching your mouth in the mirror.

### Supplies

- ☐ Wint-O-Green Lifesaver candies (no other flavour will work)
- ☐ hand mirror
- ☐ glass of water

### What's Happening?

Each time a part of a Lifesaver is crushed between your teeth you will see one or more flashes of white light in your mouth. Each piece of candy can produce many flashes of light as it is chewed and crushed.

*Triboluminescence* is the mechanical generation of light. Certain chemical bonds will generate light energy when the molecules are torn apart by mechanical crushing. Wint-O-Green lifesaver candies contain some of these bonds.

### Program Connections

**Guides:**            **Related Interest Badges:** Physics (8), Science (5)  
**Pathfinders:** **Exploring a Theme:** Everything Comes from STEM (1)

# Colours of Light (B,G,P)

## Directions

1. Place the candle on a table and light it.
2. Dim the lights.
3. Hold the CD or DVD with the shiny side facing the candle and look at the flame reflected on the surface.
4. What do you see? Do you see the candle reflected just like in a mirror?
5. What is happening?

## Supplies

- ☐ candle
- ☐ old CD or DVD
- ☐ matches

## What's Happening?

The shiny surface of the CD or DVD acts like a prism and allows the candlelight to split into its constituent colours. The wavelengths of light split into the same pattern as you learned in "Rainbow M&M's." Roy G. Biv works again.

## Program Connections

**Brownies:** Interest badge: Key to STEM Special Interest Badge

**Guides:** Related Interest Badges: Physics (8), Science (5)

**Pathfinders:** Exploring a Theme: Everything Comes from STEM (1)

# Laser Show (B,G,P)

## Directions

1. Girls can work in pairs or small groups.
2. Attach the binder clip or clothespin to the bottom of one side of the mirror. The clip or clothespin will act as a stand.
3. Place the protractor page on a flat surface. Make sure the mirror lies flat on the paper.
4. Balance the mirror on top of the flat line of the bottom of the protractor.
5. Pick a number on the protractor and shine the laser horizontally along the line aimed at the centre point on the protractor at the mirror. Ask your partner to hold her hand touching the table in front of the number on the other side of the protractor.
6. What happens to the laser light? What number does the reflected laser beam shine on?
7. Try a different number on the half circle. Does the light reflect to the same number on the other side?

## Supplies

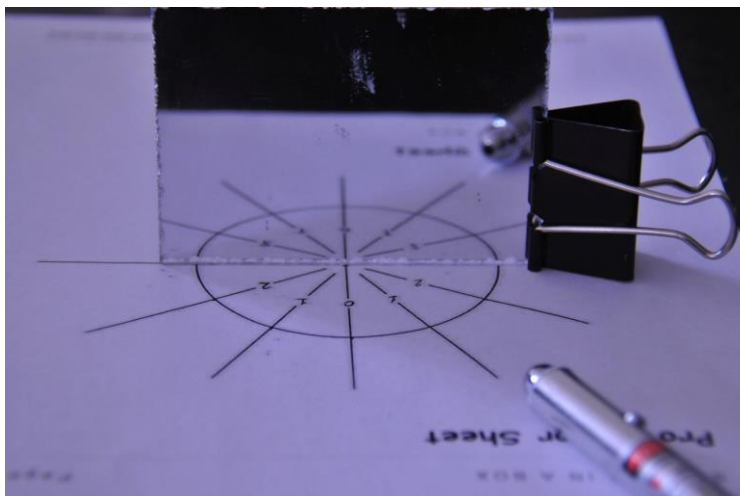
- ☐ red laser pointer
- ☐ mirror, rectangular
- ☐ binder clip or clothespin
- ☐ printed pages of a protractor

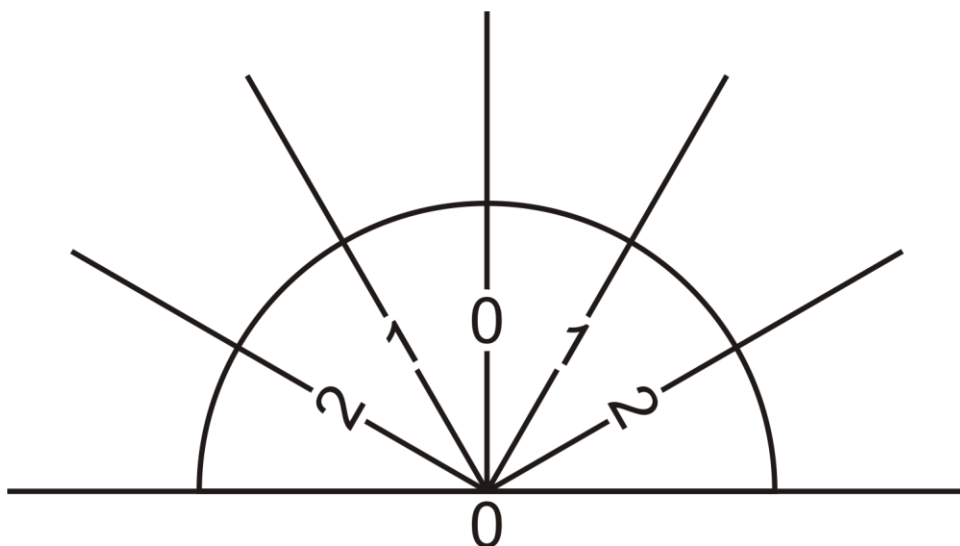
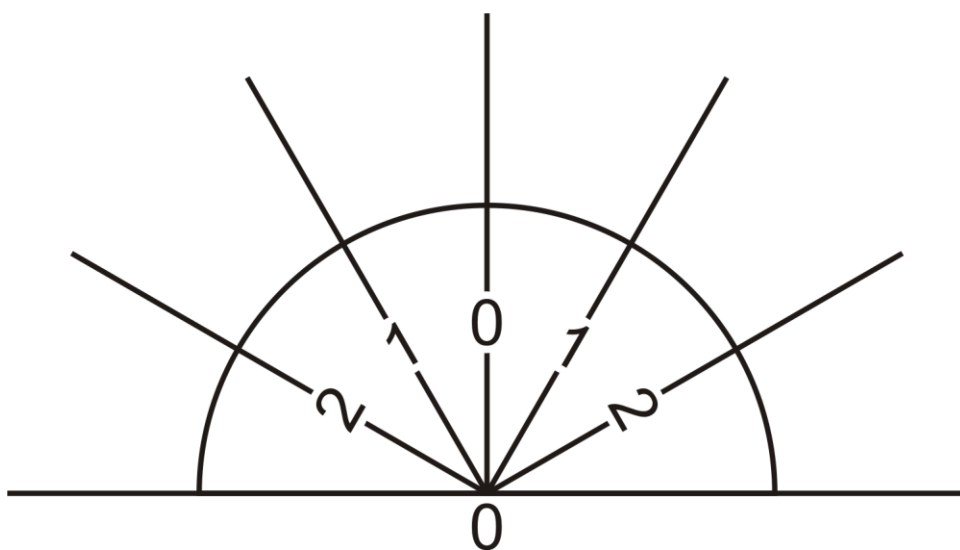
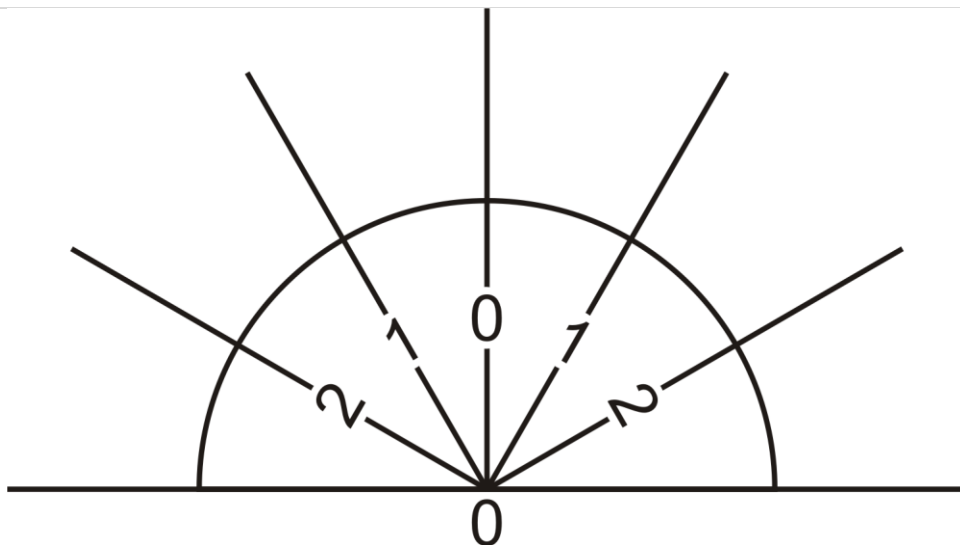
## What's Happening?

Light is reflected from a mirror at the same angle that the light approached it. When you hold the laser pointer along line "0", it is reflected straight back at the laser pointer. But if you place the laser pointer to shine along line "1", it is reflected at an angle and back on the opposite line "1". If you measure the angle from the mirror to the line, it is the same angle from the mirror to the reflected line. This is called the angle of reflection and the number will always be the same.

## Program Connections

**Brownies:** Interest badge: Key to STEM Special Interest Badge  
**Guides:** Related Interest Badges: Physics (8), Science (5)  
**Pathfinders:** Exploring a Theme: Everything Comes from STEM (1)





## Electricity & Magnetism

Electricity happens when electrons move. Sometimes electrons will accumulate on the surface of an object until there is so much charge that they jump to a place that will dissipate the charge. That's what happens with static electricity when you touch a metal doorknob after dragging your feet on the carpet. It is also what happens when lightning strikes: electrons that build up on clouds moving past each other finally can't hold all the charge and the electrons explosively rush to the ground or a tall object. We can also make electrons move using a magnet. When scientists discovered that fact, they realized that electricity and magnetism are linked. Electricity causes magnetism and magnets can make electricity. It's like magic, but it's really science.

### All Charged Up (S,B,G,P)

#### Directions

1. Preparation before the meeting: Put about one cup of Styrofoam pellets into the clear plastic bottle. Seal the bottle with the cap.
2. Tap the bottle on the table to show the girls that the Styrofoam pellets fall to the bottom due to the force of gravity.
3. Ask the girls to rub the wool on the bottle for at least a minute.
4. Observe what happens to the Styrofoam pellets at the top of the bottle.

#### Supplies

- ☐ clear plastic bottle with lid
- ☐ Styrofoam pellets
- ☐ wool cloth

#### What's Happening?

When you run the wool on the plastic bottle, it picks up electrical charge called static electricity. The Styrofoam pellets also become charged, defying gravity by sticking to the side of the bottle. In this case, the force of the static charge is greater than the force of gravity trying to pull the foam pellets to the bottom of the bottle. All you have to do is tap the bottle on the table to knock the pellets back to the bottom and start again.

#### Program Connections

**Sparks:** Exploring and Experimenting Keeper  
**Brownies:** Interest badge: Key to STEM Special Interest Badge  
**Guides:** Related Interest Badges: Physics (8), Science (5)  
**Pathfinders:** Exploring a Theme: Everything Comes from STEM (alternate activity)

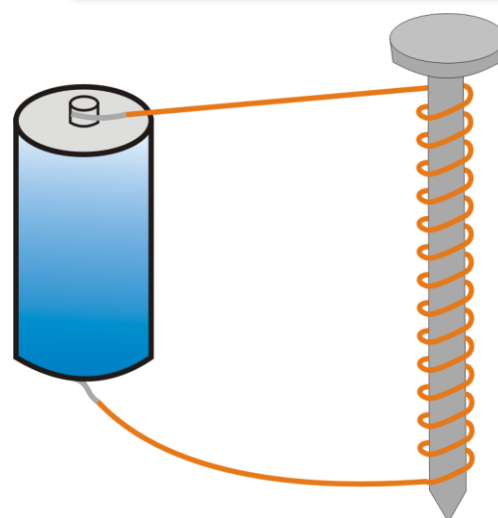
# Make an Electromagnet (S,B,G,P)

## Directions

1. If the ends of the wire are not already stripped, use a pair of wire strippers to remove a few centimeters of insulation from each end of the wire. (Do this prior to the meeting).
2. Leaving the ends free, tightly wrap the wire around the nail, spiraling around in one direction, and not overlapping the wire. The more wire you can wrap around the nail (very tightly), the stronger your electromagnet will be. It is very important that you wrap the wire in just one direction around the nail.
3. Connect one end of the wire to the positive (+) terminal of the battery, and the other end to the negative (-) terminal. Use the electrical tape to tape the wires in place. **Important: don't leave your battery connected for more than a minute, as this activity drains the battery very quickly.**
4. Touch the wrapped nail to the paperclips – you should be able to lift them up with your electromagnet. The more turns of wire you have around your nail, the stronger your electromagnet will be.
5. Try experimenting with different lengths of wire, different sizes of nails, or different nail materials.

## Supplies

- ☐ large iron nail
- ☐ insulated copper wire with the ends stripped (i.e. remove plastic from the ends) – thin insulation is best (long enough to wrap tightly around the full length of the nail)
- ☐ fresh D-cell battery
- ☐ electrical tape
- ☐ small paperclips



## What's Happening?

Electromagnets are magnets that run on electricity. They can be turned on and off, and only work when the electricity is flowing. In this activity, the electricity is supplied by the battery. An electric current produces a magnetic field. When the wire is formed into loops around the nail, the magnetic field is concentrated along the loops. It is then strengthened with the iron core (the nail). The atoms in the nail normally would point in random directions, but the magnetic field from the current makes all the atoms point in the same direction, creating a stronger magnetic field.

## Program Connections

**Sparks:** Exploring and Experimenting Keeper  
**Brownies:** Interest badge: Key to STEM Special Interest Badge  
**Guides:** Related Interest Badges: Physics (8), Science (5)  
**Pathfinders:** Exploring a Theme: Everything Comes from STEM (alternate activity)

# Magnet Race (S,B)

## Directions

1. Let the girls decorate their bugs.
2. Slide a paper clip onto the bug.
3. Two girls race their bugs on the track by holding a magnet beneath their bug under the cardboard.
4. The bugs need to stay inside the track all the way from start to finish.

## What's Happening?

The paper clip on the bugs is metal and will couple to the magnet held under the track. The girls will learn how to navigate the track even though they can't see where their hand is with the magnet, only where the bug is on top of the track.

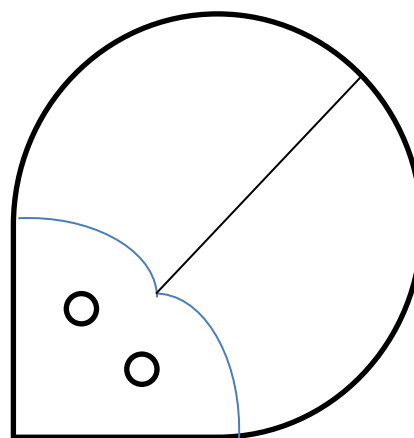
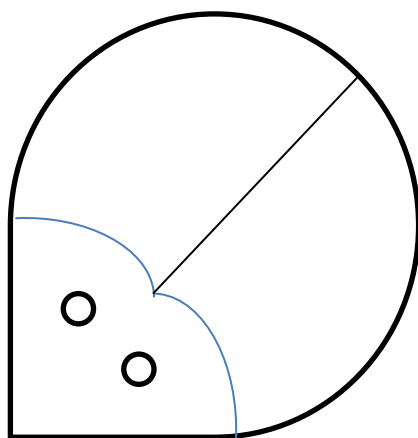
## Supplies

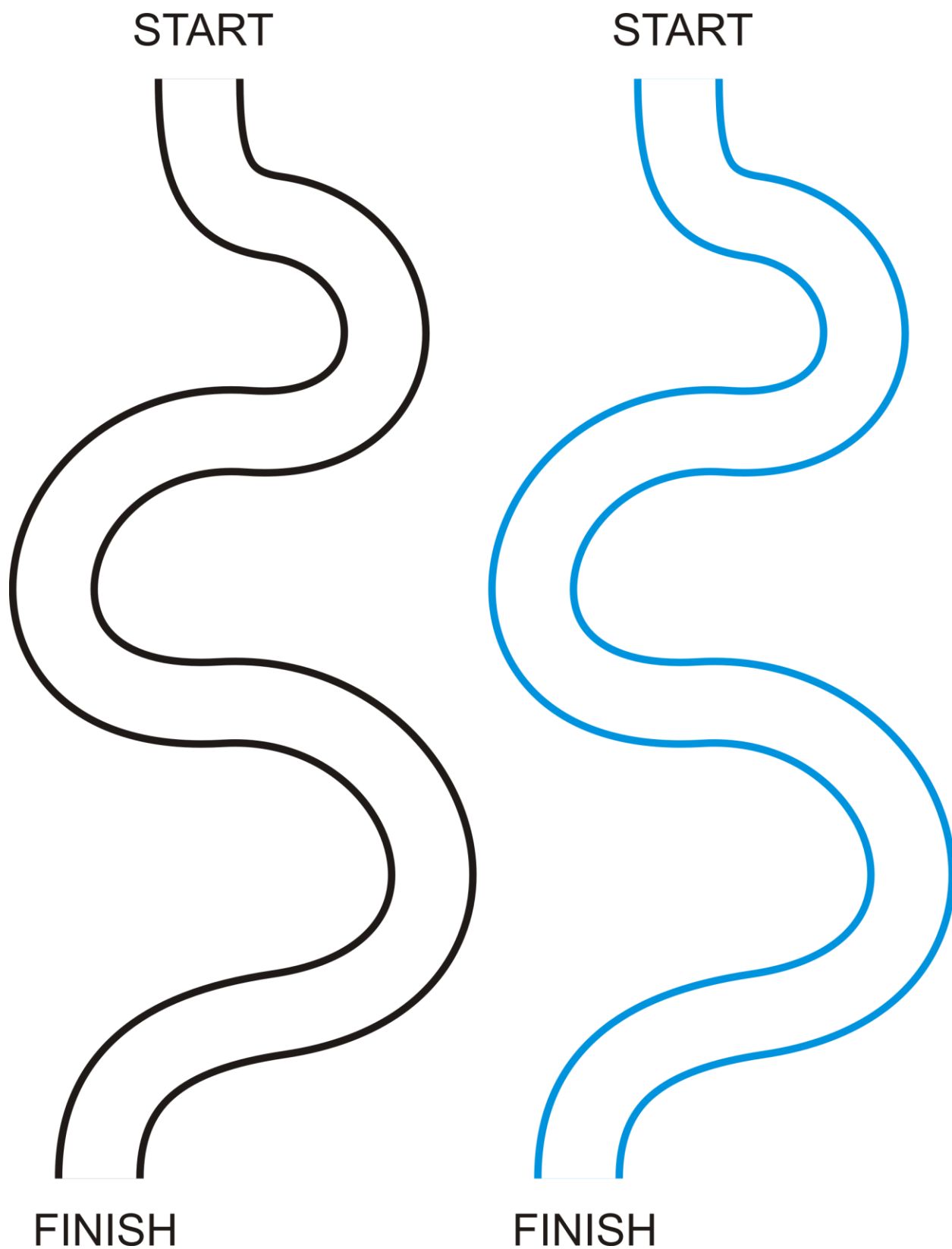
- ☐ track printed on paper, or make your own
- ☐ thin cardboard with the track taped on top (the side of a cereal box works great)
- ☐ large paper clips (not the plastic coated type)
- ☐ bug cut outs
- ☐ magnets
- ☐ crayons or markers

## Program Connections

**Sparks:** Exploring and Experimenting Keeper

**Brownies:** Interest badge: Key to STEM Special Interest Badge



**Magnet Race Track**

# Dancing Guide Dolls (S,B,G)

## Directions

1. Fold the paper from top to bottom. From the first fold, continue to accordion fold the paper at about 3 cm intervals.
2. Using the Guide doll template, draw the right half of the doll along the first fold (see the illustration below).
3. Cut along the lines that you drew without opening the folded paper. Form a circle of dolls by taping the two ends of the group together.
4. Attach the paperclips so that the dolls stand on them.
5. Balance the large sheet of cardboard so that a portion of it hangs over the edge of a table. Stand the circle of paper dolls on top of the cardboard so that one of the clips is on the overhanging side.
6. Move the magnet under the paperclip, then drag the magnet right and left to make the dolls dance.

## Supplies

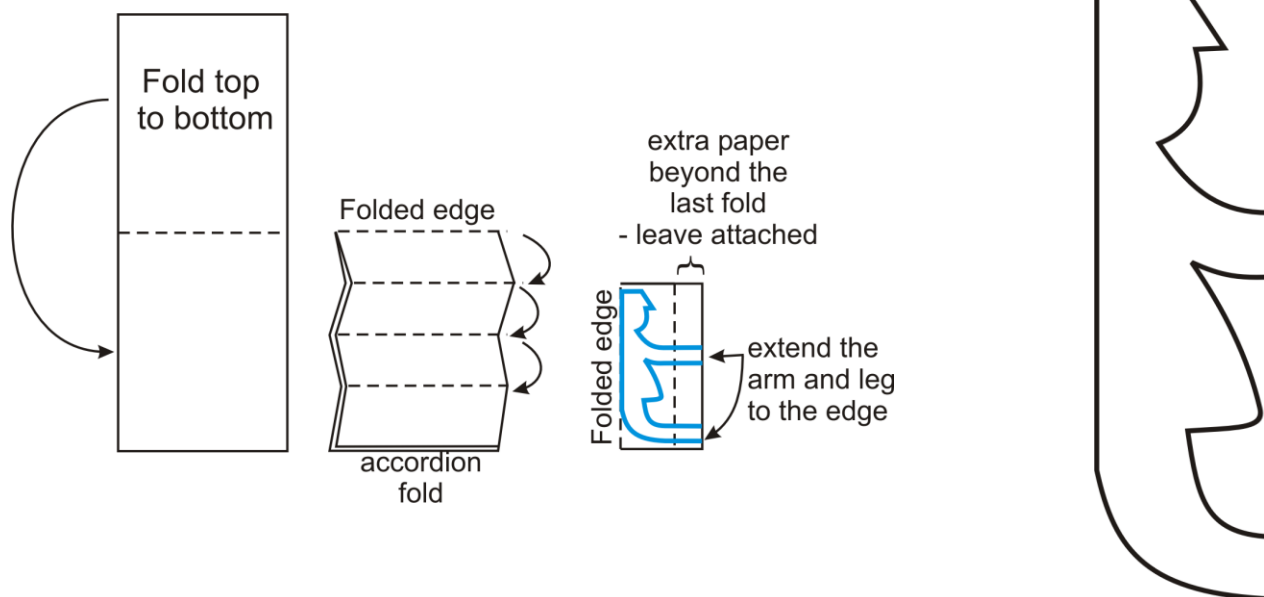
- ☐ paper, cut in half along the long side, 4¼" x 11"
- ☐ Guide doll template, enlarge to desired size (or draw your own)
- ☐ pencil
- ☐ scissors
- ☐ tape
- ☐ large sheet of cardboard
- ☐ 2 paperclips (not the plastic coated type)
- ☐ magnet

## What's Happening?

The paperclips are made of steel wire. The magnet attracts them through the cardboard, causing the dolls to move around with the magnet.

## Program Connections

**Sparks:** Exploring and Experimenting Keeper  
**Brownies:** Interest badge: Key to STEM Special Interest Badge  
**Guides:** Beyond You: Try New Things; 6. Activity of Choice  
**Related Interest Badges:** Physics (8), Science (5)



## Force and Motion

Forces are all around us. A force is a push or pull upon an object. A force can cause an object to move faster, slower, change direction or change shape.

### Rock versus Paper (S,B,G)

#### Directions

1. In one hand hold a flat piece of paper and in the other hold a small rock.
2. Hold out your hands at the same height. Predict which one will hit the ground first.
3. Drop both the rock and paper at the same time. What do you observe? Why?
4. Pick up the paper and rock and repeat the activity, this time scrunching the sheet of paper into a small ball. Predict what will happen.
5. Drop the paper ball and the rock at the same time. What do you observe? Why was the result different this time?

#### Supplies

- ☐ small rock
- ☐ sheet of paper

#### What's Happening?

Gravity is the universal force of attraction in space. Every object that has mass exerts gravity on every other object of mass. It holds us on the Earth and keeps the planets in orbit around the sun. In the first attempt, the paper loses the race because air resistance keeps the paper from falling at the same rate as the rock. But when you scrunch up that same piece of paper and reduce the effect of air resistance, both hit the floor at the same time, as they should. This also clearly demonstrates that even though you can't see air, it has mass and occupies space and has to move out of the way of any object falling to the ground.

#### Program Connections

**Sparks:** Exploring and Experimenting Keeper  
**Brownies:** Interest badge: Key to STEM Special Interest Badge  
**Guides:** Beyond You: Try New Things; 6. Activity of Choice  
Related Interest Badges: Physics (8), Science (5)

# Cantilevered Books (B, G)

## Directions

1. Stack the books on the edge of the table.
2. Slide the top book halfway out from the stack and over the table's edge. When it balances, slide it back a little.
3. Move the next book out without changing the position of the top book on it. Find the balance point, then slide the book back a bit.
4. Continue this sequence until all six books are staggered.
5. Observe how far the top book leans out over the edge of the table.

## Supplies

- ☐ 6 notebooks or thin books
- ☐ table

## What's Happening?

The top book appears to be suspended in air, but more than half of the weight of the stack of books is still resting on the table. The center of gravity remains on the table.

## Program Connections

**Brownies:** Interest badge: Key to STEM Special Interest Badge  
**Guides:** Beyond You: Try New Things; 6. Activity of Choice  
Related Interest Badges: Physics (8), Science (5)

# Balancing Hammer (B,G,P)

## Directions

1. Tie one end of the string to the middle of the ruler.
2. Tie the other end of the string to the hammer.
3. Place the ruler with one end of the ruler on top of the table.
4. Position the hammer with the head under the table pointed along the same axis as the ruler.
5. Move the ruler with the hammer properly positioned until it is balanced. Let go of the hammer. Observe what happens.

## Supplies

- ☐ hammer with a wooden handle
- ☐ ruler
- ☐ string, 30 cm long
- ☐ table

## What's Happening?

The head of the hammer is the heaviest part of the system (ruler attached to hammer via string). When the head of the hammer is suspended under the table, the centre of gravity is supported by the part of the ruler that is on the table, not the overhanging section. If the centre of gravity moves over the overhanging section, the hammer will fall. It is important to use a hammer with a wooden handle. Hammers with a metal handle have a different centre of gravity and won't work.

## Program Connections

**Brownies:** Interest badge: Key to STEM Special Interest Badge

**Guides:** Beyond You: Try New Things; 6. Activity of Choice

**Related Interest Badges:** Physics (8), Science (5)

**Pathfinders:** Exploring a Theme: Everything Comes from STEM (alternate activity – do a variety of activities to learn about Force and Motion)

# Checkered Games (G,P)

## Supplies

- ☐ a lot of checkers

## Directions

1. Bend your arm with your elbow up (forearm level to the floor) and your hand next to your shoulder, palm up.
2. Place a checker on the flat area next to your elbow.
3. Try to catch the checker in the hand on the same arm by quickly swinging your elbow down and rotating your hand to the location where your elbow started.
4. When you master this action, try it with 2 stacked checkers, then three. See how many you can catch.
5. Play a relay game by dividing into two groups. Place a table at one end of the room and a second table at the opposite end.
6. To play the relay game, have half of each team at each table. The girls will take turns placing a checker on her elbow and catching it. If she drops the checker, she must pick it up and try again. Once she successfully catches the checker, she runs to the other side and gives the checker to the next girl. The team that finishes first wins.

## What's Happening?

As your elbow moves down from under the checker, your hand comes down toward the checker. If your timing is right, you can catch the token. There is a slight delay before the checker starts to fall. This is called inertia, which gives you time to rotate your hand around to catch it.

## Program Connections

**Guides:** **Beyond You: Try New Things;** 4. Learn about inertia; 6. Activity of Choice

**Related Interest Badge:** Physics (8), Science (5)

**Pathfinders:** **Exploring a Theme:** Everything Comes from STEM (alternate activity – do a variety of activities to learn about Force and Motion)

# Checkered Tricks (G,P)

## Directions

1. Build a stack of eight or ten checkers.
2. Place another checker on the table next to the stack, about 3 cm away.
3. Using your forefinger, flick the single checker toward the stack of checkers, trying to knock out the bottom one. You need to flick it really hard and make sure it goes flat across the surface.

## Supplies

- ☐ a lot of checkers, the checkers need to have a smooth edge, alternatively, use loonies
- ☐ a ruler
- ☐ a flat surface

## What's Happening?

This is inertia at work again. The stack of checkers wants to remain in place when the rogue checker strikes the stack. The bottom checker will fly away while the rest of the checkers stay in their stack and drop to the table.

## Extension

Try using a ruler to dislodge a middle checker instead of the bottom one. To do this, you must be sure to hit only one checker and hit it hard enough to cause it to fly out without knocking over any other checkers.

## Program Connections

**Guides:** **Beyond You: Try New Things:** 4. Learn about Inertia; 6. Activity of Choice

**Related Interest Badges:** Physics (8), Science (5)

**Pathfinders:** **Exploring a Theme:** Everything Comes from STEM (alternate activity – do a variety of activities to learn about Force and Motion)

# Spinning Loonies (G,P)

## Directions

1. Hang the plastic clothes hanger on a pointer finger, with all other fingers curled out of the way.
2. Balance a loonie on the bottom of the hanger, directly below your pointer finger that is supporting the hanger hook end.
3. When the loonie is balanced, begin rocking the hanger gently back and forth on your finger. Gradually speed it up until you can get it to do a full loop-de-loop.

## Supplies

- ☐ several loonies
- ☐ a clothes hanger, made of thick plastic

## What's Happening?

You create centrifugal force as the hanger swings around. The coin will stay in place as long as you keep the hanger spinning and don't jerk it in a perpendicular direction.

## Program Connections

**Guides:** **Beyond You: Try New Things;** 4. Learn about Inertia; 6. Activity of Choice

Related Interest Badges: Physics (8), Science (5)

**Pathfinders:** **Exploring a Theme:** Everything Comes from STEM (alternate activity – do a variety of activities to learn about Force and Motion)

# Bernoulli's Fun with Ping Pong Balls

## (S,B,G,P)

### Directions

1. Turn the hair dryer onto the highest fan setting. If there is a heat setting, turn that to the lowest setting.
2. Hold the hair dryer pointed straight up.
3. Hold a Ping-Pong ball about 2 cm above the hair dryer.
4. Turn the hair dryer on.
5. Let go of the Ping-Pong ball. Observe what happens to the Ping-Pong ball.
6. Tilt the dryer to one side. What happens to the Ping-Pong ball?

### Supplies

- ☐ hair dryer, wide mouthed works better
- ☐ Ping-Pong balls

### What's Happening?

When the Ping-Pong ball is directly over the fan opening, air will completely encircle the ball, suspending it in mid-air. The Ping-Pong ball seems to float. It might move from side to side, depending on how large the dryer opening is. As the Ping-Pong balls move around, the air pressure changes and the ball will return to the place where all the forces are balanced. When you tilt the dryer to one side, the force of gravity will become greater until it is larger than the forces created by the moving air. The Ping-Pong ball will fall to the floor.

### Program Connections

**Sparks:** Exploring and Experimenting Keeper  
**Brownies:** Interest badge: Key to STEM Special Interest Badge  
**Guides:** Beyond You: Try New Things: 6 Activity of Choice  
 Related Interest Badges: Physics (8), Science (5)  
**Pathfinders:** Exploring a Theme: Everything Comes from STEM (5, (alternate activity – do a variety of activities to learn about Force and Motion)

# The Power of the Written Word (S,B,G,P)

## Directions

1. Place the ruler on a table leaving about 5 cm hanging off the edge.
2. Spread a double sheet (two pages connected) over the ruler so that the paper lies flat along the table edge.
3. Use a small but quick karate chop to hit the exposed ruler.
4. What happens?
5. Reset the newspaper (use fresh newspaper if the ruler tore it) with the ruler under it. This time slowly push down on the ruler. What is the difference?

## Supplies

- ☐ newspaper
- ☐ a ruler
- ☐ a table

## What's Happening?

Are you surprised that the newspaper stays put for the karate chop? Air pressure is pushing down on the newspaper, pushing down with about 1 kg per square cm across the entire surface. The force from you striking the ruler isn't enough to lift it because inertia is making the newspaper want to stay put. Air pressure pushes down with about 1 kg per square cm of the surface of the newspaper. When you karate chop the newspaper, all the weight of the air holds down the newspaper (unless the karate chop is sharp enough to tear the newspaper). When you slowly press down on the ruler, the force from your hand overcomes inertia and newspaper lifts easily.

## Program Connections

**Sparks:** Exploring and Experimenting Keeper  
**Brownies:** Interest badge: Key to STEM Special Interest Badge  
**Guides:** Beyond You: Try New Things; 6. Activity of Choice  
Related Interest Badges: Physics (8), Science (5)  
**Pathfinders:** Exploring a Theme: Everything Comes from STEM (alternate activity – do a variety of activities to learn about Force and Motion)

# Kissing Cans (S,B,G)

## Directions

1. Place a bunch of straws on a cookie sheet. Make sure that the straws are parallel to each other and there is space between them so that they can move a bit.
2. Place the two empty soda cans on top of the straws next to each other, about 2 – 4 cm apart.
3. Blow straight between the two cans. Make sure that the air shoots straight through the space between the cans, not at the cans.
4. Observe what happens.

## Supplies

- ☐ plastic straws
- ☐ 2 empty soda cans
- ☐ a cookie sheet with sides

## What's Happening?

The cans kiss. When you blow between the cans, you create a low pressure area. The higher pressure air around the cans pushes them towards each other.

## Program Connections

**Sparks:** Exploring and Experimenting Keeper  
**Brownies:** Interest badge: Key to STEM Special Interest Badge  
**Guides:** Beyond You: Try New Things: 6. Activity of Choice  
 Related Interest Badges: Physics (8), Science (5)  
**Pathfinders:** Exploring a Theme: Everything Comes from STEM (alternate activity – do a variety of activities to learn about Force and Motion)



# Rocketing Pinwheel (S,B,G,P)

## Directions

1. Put the straw onto a table and push the pin through it about 5 cm away from the flex section.
2. Push the pin into the top of the pencil eraser. Make sure that the pin goes through the straw but does not compress it, so that it will rotate freely. Bend the flex section to make the straw an "L" shape.
3. Blow up the balloon and twist the end to hold the air inside.
4. While holding the twist in the end of the balloon, slip the balloon opening over the end of the straw that is farthest away from the flex side. Tape the end of the balloon to the straw.
5. Hold the pencil upright and untwist the balloon and release. What happens?
6. Hold the balloon where the tape is and blow through the straw to re-inflate the balloon. Let the balloon rocket go around again.

## Supplies

- ☐ balloons
- ☐ pencils with erasers
- ☐ sewing pins
- ☐ straw, bendy type (with flexible elbow)
- ☐ tape



## What's Happening?

The balloon and straw will rocket around in a circle centered at the pin. Energy is stored by the balloon – the elasticity of the balloon is balanced by the higher air pressure inside the balloon. Once the balloon end is opened, air pushes out of the balloon and the opposite reaction causes the balloon and straw to rotate around the pin.

## Extension

Change the angle of the straw. At what angle does it spin the fastest?

## Program Connections

**Sparks:** Exploring and Experimenting Keeper  
**Brownies:** Interest badge: Making Things Go  
**Guides:** Beyond You: Try New Things; 6. Activity of Choice  
 Related Interest Badges: Physics (8), Science (5)  
**Pathfinders:** Exploring a Theme: Everything Comes from STEM (alternate activity – do a variety of activities to learn about Force and Motion)

# Spinning Water Top (S,B,G)

## Directions

1. Turn the soda can on its side and use the hammer and nail to tap four holes\* along the bottom of the can.
2. Position the holes at 90 degree angles (perpendicular) to each other. Once you have tapped the nail through the can, bend the nail down toward the can to angle the opening. Make sure to angle all the holes in the same direction.
3. Tie the string to the tab on the can.
4. Fill the can with water. Dangle the can from the string over the sink and observe what happens.

\* You might find this easier by freezing some water in the bottom of the can before tapping the holes in. This gives a solid surface to hammer instead of hammering against air.

## Supplies

- ☐ empty soda can
- ☐ nail
- ☐ hammer
- ☐ string
- ☐ water

## What's Happening?

Ever wonder why a sprinkler turns? This demonstrates Newton's Third Law of Motion – for every action there is an equal and opposite reaction. As the water spurts out of the can at an angle, there is an angular force exerted on the can. Since the can is suspended from the string, it does not have much frictional resistance to the angular force and the can begins to spin. This also demonstrates that forces act in a specific direction.

## Program Connections

**Sparks:** Exploring and Experimenting Keeper  
**Brownies:** Interest badge: Making Things Go  
**Guides:** Beyond You: Try New Things: 6. Activity of Choice  
**Related Interest Badges:** Physics (8), Science (5)  
**Pathfinders:** Exploring a Theme: Everything Comes from STEM (alternate activity – do a variety of activities to learn about Force and Motion)

# Balloon Hovercraft (B,G)

## Directions

1. Use the scissors to cut and remove the bottom from a paper cup.
2. Using the pushpin, poke about 20 holes into the plastic cap. Make sure that the holes go all the way through the plastic. When you turn the cap over, you should see tiny pinholes of light.
3. Spread a generous layer of hot glue onto the bottom rim of the cap and glue it to the center of the CD. Give it a small twist to ensure that it is secure without any air leaks at the surface of the CD.
4. Wrap an elastic band tightly around the plastic cap.
5. Blow up the balloon and twist the end. Do not tie off the balloon.
6. Secure the end over the elastic on the plastic cap, completely covering it.
7. Place the hovercraft on a smooth surface.
8. Untwist the balloon to make it hover.
9. If the hovercraft has trouble floating, make sure that it is on a very smooth surface. You also might need to add more holes to the plastic cap. Try it again. Note: once the balloon has been “exercised” the girls can blow it up again by blowing through the hole of the CD without having to remove the balloon from the cap.

## Supplies

- ☐ paper cup
- ☐ old CD or DVD
- ☐ balloon ,19-24 cm
- ☐ elastic band
- ☐ plastic cap from drink bottle
- ☐ pushpin
- ☐ hot glue gun
- ☐ scissors

## What's Happening?

The force of the air pressure escaping the balloon spreads out in all directions under the CD. The blanket of air between the CD and the floor reduces friction and allows the hovercraft to move or float, at least until the air runs out.

## Program Connections

**Brownies:** Interest badge: Making Things Go  
**Guides:** Beyond You: Try New Things: 6. Activity of Choice  
 Related Interest Badges: Physics (8), Science (5)  
**Pathfinders:** Exploring a Theme: Everything Comes from STEM (alternate activity – do a variety of activities to learn about Force and Motion)

# Train a Can to “Come” (G,P)

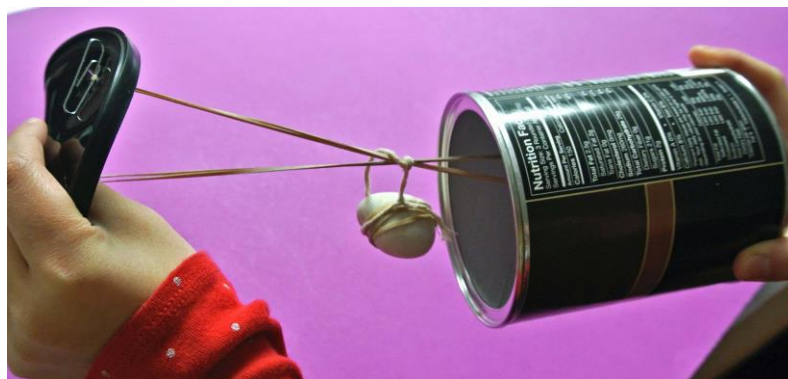
## Directions

1. Using the hammer and nail, punch two holes in the end of the coffee can, as shown. Punch two similar holes through the lid of the can.
2. Thread the end of an elastic band through each hole on the bottom of the can and wrap the extended end around a paper clip to keep it from slipping back through the hole.
3. Thread the free end of each elastic band through the lid and secure them with paper clips.
4. Tie the weight onto the string.
5. Tie the free end of the string to both elastic bands at the mid-point, as shown.
6. Twist the lid so that the elastic bands make an “X” inside the can where the string is tied. Close the lid onto the can.
7. Place the can on a smooth surface and roll it away from you. What happens?



## Supplies

- ☐ metal coffee can with lid
- ☐ 4 paperclips
- ☐ 2 elastic bands
- ☐ string
- ☐ weight, fishing sinker or bolt
- ☐ hammer
- ☐ nail



## What's Happening?

When you roll the can away from you, the weight on the string causes the elastic bands to roll up, storing energy because of a property called *elasticity*. Once the forward movement of the can stops, all of the stored energy in the elastics becomes greater than the forces keeping the can motionless and the can rolls backwards in order to unroll the elastics and return them to their original untwisted state. This activity demonstrates how energy is conserved and stored. You give the can kinetic energy that becomes stored in the elastic bands until the forces equalize and the energy in the elastics becomes greater than the kinetic energy remaining from your initial push. The can returns to you because the elastic bands give up their stored potential energy in the reverse direction. In a system without any loss of energy due to frictional losses, the can will return to the exact spot from which it started. In this case, it won't get quite that far.

## Program Connections

- Guides:** **Beyond You: Try New Things:** 6. Activity of Choice  
**Related Interest Badges:** Physics (8), Science (5)  
**Pathfinders:** **Exploring a Theme:** Everything Comes from STEM (alternate activity – do a variety of activities to learn about Force and Motion)

# How to String a Grandfather Clock (B,G,P)

## Directions

1. Tie the weight on the end of each string.
2. Suspend the 120 cm string from the hook or nail, with the weight hanging at the bottom.
3. Pull the string slightly to one side and let it swing. Count how many swings it makes in 60 seconds.
4. Pull the string farther out and repeat, counting the number of swings in 60 seconds. Write down your results.
5. Repeat this procedure with all the different lengths of string.
6. Observe what happens.

## What's Happening?

It doesn't matter how far the string is pulled to the side, the number of swings is constant for each length of string. The length of 97.5 cm happens to swing at 60 times in 60 minutes, making it the correct length to use for a clock. This makes it possible to design a clock.

## Supplies

- ☐ string, 25 cm long
- ☐ string, 50 cm long
- ☐ string, 97.5 cm long
- ☐ string, 120 cm long
- ☐ 4 identical weights, bolts or metal washers
- ☐ ceiling hook or nail located above a wide doorway
- ☐ watch with a second hand or a digital timer
- ☐ pencil
- ☐ paper

## Program Connections

**Brownies:** Interest badge: Key to STEM Special Interest Badge  
**Guides:** Beyond You: Try New Things: 6. Activity of Choice  
 Related Interest Badges: Physics (8), Science (5)  
**Pathfinders:** Exploring a Theme: Everything Comes from STEM (alternate activity – do a variety of activities to learn about Force and Motion)  
 On My Own: Skills for Around the Home (alternate)

## Simple Machines

Machines are devices used to make it easier to do work by changing the direction or magnitude of a force. Simple machines include the lever, the wedge, the wheel and axle, the inclined plane, the screw, and the rope and pulley system.

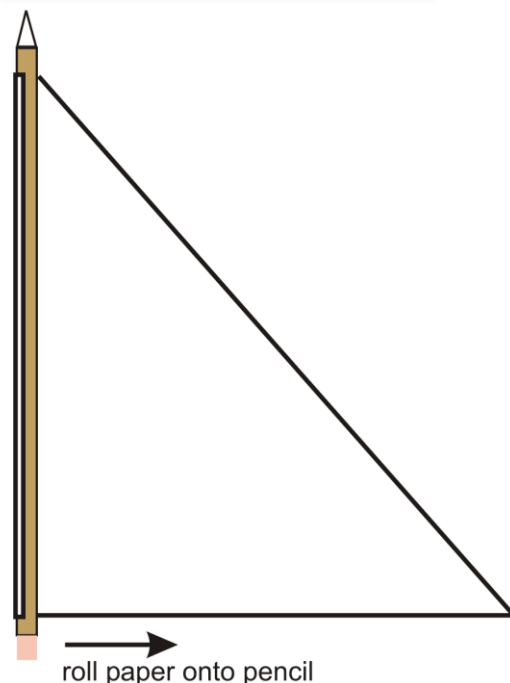
## The Screw and Ramp (B,G,P)

### Directions

1. Use the hammer to tap a nail halfway into the piece of wood.
2. Use the screwdriver to thread a screw halfway into the wood.
3. Allow the girls to use the claw side of the hammer to try to pull out the nail and then the screw. Which is harder to remove?
4. Examine the screw and notice that the threads are angled.
5. Cut a triangle from the paper. Use a marker to outline the triangle.
6. Roll the paper onto the pencil, starting by laying the pencil at the tall side of the triangle and rolling to the point while keeping the bottom straight edge even as the pencil rolls.
7. Inspect the edge of the paper on the pencil. Does it resemble the screw?

### Supplies

- ☐ piece of wood
- ☐ sheets of paper
- ☐ scissors
- ☐ pencil
- ☐ markers
- ☐ screws
- ☐ nails
- ☐ hammer
- ☐ screwdriver



### What's Happening?

The screw is a ramp that spirals up a nail.

### Program Connections

**Brownies:** Interest badge: Key to STEM Special Interest Badge

**Guides:** Beyond You: Try New Things; 6. Activity of Choice

**Related Interest Badges:** Physics (8), Science (5)

**Pathfinders:** Exploring a Theme: Everything Comes from STEM (alternate activity – Do a variety of activities to learn about simple machines)

# Get Your Bearings (B,G,P)

## Directions

1. Place one can on top of the other, bottoms touching. Place a heavy rock inside the top can. Try to turn the top can.
2. Cut a cardboard circle, 1½ cm smaller than the diameter of the can.
3. Glue the cardboard to the third can at the center.
4. Place 10 or 12 marbles into the groove between the edge of the can and the cardboard center.
5. Place the can with the rock in it on top of the marbles.
6. Try to turn the can. How does this compare with turning the can on top of the other without the marbles?

## Supplies

- ☐ 3 large tin cans, the same size with an outside lip (not a rounded edge)
- ☐ a heavy rock, small enough to fit inside the tin can
- ☐ marbles
- ☐ thick cardboard, not so thick that it is larger than the lip of the tin cans.

## What's Happening?

The marbles act like ball bearings. Since the marbles are smooth and round, they reduce friction between the two cans, making it much easier to turn the top can. Ball bearings are used in many machines to reduce friction. This reduces the amount of energy needed to power rotating equipment and it also reduces the wear on metal parts in contact. Bearings are often used between a wheel and a fixed axle (simple machine) to reduce friction, making it easier to turn the wheel.

## Program Connections

**Brownies:** Interest badge: Key to STEM Special Interest Badge

**Guides:** Beyond You: Try New Things; 6. Activity of Choice

**Related Interest Badges:** Physics (6), Science (5)

**Pathfinders:** Exploring a Theme: Everything Comes from STEM (alternate activity – Do a variety of activities to learn about simple Machines)

## Two Against One Tug (S,B,G,P)

### Directions

1. Girls need to work in threes.
2. Give a broomstick to each of two girls and position them about 1 ½ metre apart.
3. Tie one end of the rope to a broomstick. A clove hitch works well here. Wrap the rope around the other broomstick, then loop around the first broomstick and continue to weave it back and forth.
4. Have the third girl hold the end of the rope.
5. Ask the two girls holding the broomsticks to pull apart as hard as they can while the girl continues to hold the rope.
6. Can the two girls with the broomsticks pull the rope out of the third girl's hands?

### Supplies

- ☐ about 10 ft of rope or thick cord
- ☐ 2 brooms

### What's Happening?

Looping the rope between the two broomsticks creates a double pulley, which is an example of a simple machine. Each wrap of the rope around the broomsticks increases the distance that the rope has to be pulled, which increased the amount of force needed.

### Program Connections

**Sparks:** Exploring and Experimenting Keeper  
**Brownies:** Interest badge: Key to STEM Special Interest Badge  
**Guides:** Beyond You: Try New Things; 6. Activity of Choice  
 Related Interest Badges: Physics (6) Science (5)  
**Pathfinders:** Exploring a Theme: Everything Comes from STEM (alternate activity – Do a variety of activities to learn about simple machines)

## APPENDIX 1: RESOURCES

### Online Searches

For additional science activities, search online. These links can aid in your search.

Applied Science:

<https://www.google.com/search?q=applied+science+activities+for+kids> or  
<https://www.google.com/search?q=engineering+activities+for+kids>

Biology: <https://www.google.ca/search?q=biology+activities+for+kids>

Botany: <https://www.google.ca/search?q=botany+activities+for+kids>

Human Biology: <https://www.google.ca/search?q=human+biology+activities+for+kids>

Chemistry: <https://www.google.com/search?q=chemistry+activities+for+kids>

Computer Science:

<https://www.google.com/search?q=computer+science+activities+for+kids>

Earth Science: <https://www.google.com/search?q=earth+science+activities+for+kids>

Geology: <https://www.google.ca/search?q=geology+activities+for+kids>

Meteorology: <https://www.google.ca/search?q=meteorology+activities+for+kids>

Oceanography: <https://www.google.ca/search?q=oceanography+activities+for+kids>

Astronomy: <https://www.google.ca/search?q=astronomy+activities+for+kids>

Environmental Science:

<https://www.google.com/search?q=environmental+science+activities+for+kids>

Forensic Science:

<https://www.google.com/search?q=forensic+science+activities+for+kids>

Physics: <https://www.google.ca/search?q=physics+activities+for+kids>

Light and Sound: <https://www.google.ca/search?q=light+sound+activities+for+kids>

Electricity & Magnetism:

<https://www.google.ca/search?q=electricity+magnetism+activities+for+kids>

Force & Motion: <https://www.google.ca/search?q=force+motion+activities+for+kids>

Simple Machines:

<https://www.google.ca/search?q=simple+machines+activities+for+kids>

**Books**

Science in Seconds for Kids, Jean Potter, 1995, Josey-Bass A Wiley Imprint, San Francisco, ISBN 0-471-04456-3

365 Simple Science Experiments, E. Richard Churchill, Luis V. Loeschnig, Muriel Mandell, 1997, Sterling Publishing Company, Inc., New York, ISBN 0-8069-1789-X

The Most Explosive Science Book in the Universe, Claire Watts, 2009, Dorling Kindersley Limited, A Penguin Company, London, ISBN 978-1-40533-666-6

Science Is...A Source book of fascinating facts, project and activities, Susan V. Bosak, 2000, Scholastic Canada, Ltd, Ontario, Canada, ISBN 0-590-74070-9

Science for Kids, 39 Easy Engineering Experiments, Robert W. Wood, 1992, TAB Books, A Division of McGraw-Hill, Inc, USA, ISBN 0-8306-3943-7

Awesome Experiments in Electricity & Magnetism, Michael A. Dispezio, 2006, Sterling Publishing Co., Inc., New York, ISBN 978-1-4027-2370-4

175 Science Experiments to Amuse and Amaze Your Friends, Brenda Walpole, 1988, Random House, New York, ISBN 0-394-89991-1

Save the Earth Science Experiments, Elizabeth Snoke Harris, 2008, Sterling Publishing Co., Inc., New York, ISBN 978-1-60059-322-2

Science Crafts for Kids, Gwen Diehn and Terry Krautwurst, 1994, Sterling Publishing Co., Inc., New York, ISBN 0-869-0283-3

## APPENDIX 2: PROGRAM CONNECTIONS SUMMARY

### Spark Program Connections

#### Being Healthy Keeper

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| Iron Fortified ..... | 21 |
| Slippery Stuff ..... | 26 |

#### Exploring and Experimenting Keeper

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| Life Sized Body Map .....          | 16 |
| Taste Test .....                   | 17 |
| Using Your Nose .....              | 18 |
| Iron Fortified .....               | 21 |
| Check out this Oobleck .....       | 22 |
| Freeze and Thaw! .....             | 23 |
| Rescue the Ice Cube .....          | 25 |
| Slippery Stuff .....               | 26 |
| Listen to the Lifeguard! .....     | 28 |
| Rainbow M&M's .....                | 32 |
| What a Gooooooo-d Time! .....      | 35 |
| Balloon Blowing .....              | 36 |
| Vitamin Packed .....               | 40 |

#### Going Camping Keeper

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| Rock On .....                           | 42 |
| Form a Fossil .....                     | 45 |
| Creating Constellations .....           | 48 |
| All Charged Up .....                    | 55 |
| Make an Electromagnet .....             | 56 |
| Magnet Race .....                       | 57 |
| Dancing Guide Dolls .....               | 59 |
| Rock versus Paper .....                 | 60 |
| Bernoulli's Fun with Ping Pong Balls .. | 66 |
| The Power of the Written Word .....     | 67 |
| Kissing Cans .....                      | 68 |
| Rocketing Pinwheel .....                | 69 |
| Spinning Water Top .....                | 70 |
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#### In My Community Keeper

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## Brownie Program Connections

**Key to Active Living: 3. Fabulous Food**  
Iron Fortified ..... 21

**Key to I Can: 1. Staying Safe**  
Listen to the Lifeguard!..... 28

**Key to Living World: 2. Plant Life**  
How Does Water Climb a Tree?..... 15

**Key to STEM: 3. CABOOSH!**  
Iron Fortified ..... 21  
Check out this Oobleck ..... 22  
Rescue the Ice Cube ..... 25  
Slippery Stuff ..... 26  
Listen to the Lifeguard!..... 28  
Rainbow M&M's ..... 32

**Key to STEM: 6. Reach for the Stars!**  
Finding Stars ..... 47  
Creating Constellations ..... 48

## Brownie Interest Badges

### Exploring Space

Finding Stars ..... 47  
Creating Constellations ..... 48

### Key to STEM Special Interest Badge

Life Sized Body Map ..... 16  
Taste Test ..... 17  
Using Your Nose ..... 18  
Amazing Eye Tricks..... 19  
Rock On ..... 42  
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Colours of Light ..... 52  
Laser Show ..... 53  
All Charged Up ..... 55  
Make an Electromagnet ..... 56  
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### Making Things Go

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Spinning Water Top..... 70  
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### Team Together

Science in the Deep Freeze ..... 24

**Key to Active Living: 4. Germ Buster**  
Slippery Stuff..... 26

**Key to the Living World: Add. Activity**  
Form a Fossil ..... 45

What a Gooooooo-d Time! ..... 35  
Balloon Blowing..... 36  
Poppin' Rockets ..... 38  
Elephant Toothpaste ..... 39  
Vitamin Packed ..... 40

Dancing Guide Dolls..... 59  
Rock versus Paper ..... 60  
Cantilevered Books ..... 61  
Balancing Hammer..... 62  
Bernoulli's Fun with Ping Pong Balls.. 66  
The Power of the Written Word ..... 67  
Kissing Cans ..... 68  
How to String a Grandfather Clock..... 73  
The Screw and Ramp..... 74  
Get Your Bearings..... 75  
Two Against One Tug..... 76

### Water, Water Everywhere

How Does Water Climb a Tree?..... 15  
Freeze and Thaw! ..... 23  
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## Guide Program Connections

### Beyond You: Learn About Our Environment

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### Beyond You: Try New Things

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| Iron Fortified .....          | 21 |
| Check out this Oobleck .....  | 22 |
| Listen to the Lifeguard!..... | 28 |
| Mix and Match .....           | 33 |
| What a Gooooooo-d Time! ..... | 35 |
| Balloon Blowing.....          | 36 |
| Put Out That Candle.....      | 37 |
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| Dancing Guide Dolls.....      | 59 |
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| Balancing Hammer.....                   | 62 |
| Checkered Games .....                   | 63 |
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| Bernoulli's Fun with Ping Pong Balls .. | 66 |
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| Rocketing Pinwheel.....                 | 69 |
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| Two Against One Tug.....                | 76 |

### Discovering You: Stay Fit and Healthy

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| Slippery Stuff .....    | 26 |

## Guide Interest Badges

### Astronomy

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| Creating Constellations ..... | 48 |

### Body Works

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| Taste Test .....        | 17 |
| Using Your Nose .....   | 18 |
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### Chemistry

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| Make Metal Float.....         | 30 |
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### Basic Camper

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### Camp-out

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**Guide Interest Badges (continued)****Fire Safety**

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**Physics**

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| Make an Electromagnet .....      | 56 |
| Dancing Guide Dolls.....         | 59 |
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**Plants and Animals**

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**Science**

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| Colourful Convection .....       | 44 |
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**Tasty Treats**

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**Naturalist**

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