# Conservation of Energy

**(ball experiment and planes)**

**A FACILITATOR'S GUIDE**

# Photo

*Developed by **person's name in black bold font if applicable** for Let's Talk Science in Ottawa*

**Thank you for volunteering for Let's Talk Science! The following manual will help guide you through the workshop. Please read this manual before visiting the group you are working with.**

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# Important Notes

## Introduction & Guidelines

- This manual is meant as a guide to help you prepare for your activity. The introduction includes questions that get at the curriculum link/science concept the workshop covers. You are not expected to memorize this manual. It is a guide and we want you to bring your own experiences and your style of teaching into it.

- As a general guideline, do not speak longer than the age of the students at one time.

- Most workshops fit well in a 1-hour time period but some like bridge building or some high school activities are a little longer.

- Practice your introduction and test out the activities beforehand so you can anticipate sections that may take more time or may be difficult for students.

- If you are working with a partner, work out roles and responsibilities before the visit.

- Be sure to leave time for clean-up and bring the kit back to the kit closet where you picked it up, free of garbage or food and close to how you received it. Additionally, you can inform the kit coordinator of any supplies that need replenishing.

## Safety

As a Let's Talk Science volunteer, safety must be foremost in our minds during all activities. As STEM role models, volunteers must always also model safe science practices.

Always keep in mind the following precautions:

- Emphasize and demonstrate appropriate safety procedures throughout the presentation.
- Be professional but have fun.
- Keep workspaces clean to avoid tripping hazards.
- Allergens should have been checked before reserving the kit (e.g. allergies to latex).
- **Activity Specific Safety:**
    - When using the paper airplanes, ensure that everyone is facing the same direction when they launch because they will hurt if they get in someone's eye.

## WHMIS

An overview of Canada's Workplace Hazardous Materials Information System (WHMIS) is included in these materials at the end of this manual where needed. No WHMIS sheets are included with this activity.

# Overview of the Workshop

## Grade Level and Curriculum Learning

**Grade 5:** add curriculum learning in black font

## Materials

### Activity 1: Ball Experiment

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|---|
| 8 balls (1 ball per group **x** 8 groups) |
| 8 sheets of paper that have been cut lengthwise into 1/3 width of a 8.5 **x** 11 piece of paper per group |
| Scotch tape |
| 1 ruler per group (to tape the sheets together and to the wall) |
| Pencils (the students will already have these) |

### Activity 2: Planes

| |
|---|
| Card stock triangles |
| Paper clips |
| Elastics/rubber bands |
| Paper straws |
| Scissors |
| Tape |
| Ribbons and stickers |
| Safety goggles (or otherwise instruct safety) |

***Before the activity (e.g. day/night before):***

- N/A

## Timing of the Workshop

| | Approx. Time (min) | Description |
|---|---|---|
| **Introduction** | | Introduce yourself, find out what they already know, add in bits to fit with the curriculum learning |
| **Activity 1: Ball Experiment** | | |
| **Activity 2: Planes** | | |
| **Wrap up** | | Discussion on their findings |

# Activity

***NB:*** *The questions you might ask or some things you might say are in blue font and the possible answers are in square brackets in black font. Actions are in purple font.*

## Set-Up

You can either have students sit on the floor or at their desks/tables for the introduction (somewhere where they can see the chalkboard, whiteboard, or flip chart paper). Each of you introduce yourself and then one volunteer does the introduction while the other can quietly prepare the materials need for the Ball Experiment. Make sure you wait until after the introduction to *distribute* the materials.

## Introduction

Hi everyone! We are Let's Talk Science volunteers. We come to schools and do hands-on activities. I study [simple terms] _____ at the University of Ottawa/Carleton University. I decided to study _____ because [when I was your age I loved… I think it's important to… I'm curious about…].

We're/I'm here today to put a general overview of what will be done here in blue font
**What is energy?** [various answers, but you'd like to hear something like the ability of a system to do *work,* or transfer heat, or anything that can carry out an action or maintain a process (e.g. heat our homes)].

Energy is not something we can hold or see (but sometimes we can feel it as heat, like when we touch a lightbulb that has been on – it's hot), but it is what gives us the ability to do *work*. *Work* has a special meaning in science. **Does anyone know what it means to "do work" in science?** [probably not, but they might give some guesses].

In physics, *"work"* means a force is applied to something and there is movement.

Action: Write " Work = Force **x** Distance" on the blackboard/whiteboard.

**What's a force?** [push or pull, gravity, magnetism, etc.].

So, if I apply a force (push) to this wall and it doesn't move…

Action: Point to a wall close to you and push on it (as an example).

**…Have I done "work"?** [no].

But if I apply a force (push) to this desk and it *does* move…

Action: Point to an empty desk close to you and push on it (as an example).

**…Has work been done?** [yes].

Energy is what allows us to do work or maintain a process like heat our homes. Energy cannot be created or destroyed – this is a law in science called *the first law of Thermodynamics*. But, we can change the energy from one form to another and today you're going to do an experiment where you will need to think about where the energy went (what it transformed into).

**What are some forms of energy?** [electrical, light, sound, gravitational, nuclear, geothermal].

**What are some sources of energy?** [sun/solar, wind, biomass (plants use energy from the sun and we can sometimes harness that energy for human use), falling water (dams), fossil fuels, uranium].

**Can someone think of an example of where we take one of these sources of energy and it becomes transformed to another form of energy?** [the energy from falling water becomes electrical energy; we use chemical energy from the food we eat which gets transformed into mechanical energy that allows us to run, jump, walk, etc.; because sound energy can be transformed to electrical energy, we are able to talk/communicate using radio and phones; etc.].

We can also take different materials that store energy and use or harness the energy that escapes. **Does anyone know the term for energy that is stored?** [potential energy].

Here's a question I want you to think about for a minute – you can talk to your group members about this. **How would you raise your potential energy?** [they may not have any answers because this is the first time they will have likely heard the word *potential energy* unless they are part way through the unit on energy].

Action: Ask one of the students to show or tell you how they might do this. If they come up with something like – stand on a chair or the desk – get them to show this; if they don't come up with this, get them to do it anyway.

Now, we can see that *[insert student's name here]* has raised his potential or stored energy. **How could he/she use that stored energy to get off the desk?** [jump of the desk – get the student to do this (spot the student so they don't fall)]. Okay, so *[insert student's name here]* changed from having potential energy to having the energy of motion. **Does anyone know what the energy of motion is called?** [kinetic energy].

So now we know the terms for stored energy (or *potential energy*) and energy of motion (or *kinetic energy*). There's a lot we could discuss about energy, renewable and non-renewable forms of energy, and why we need to conserve energy, but for today we are going to look at how energy is transformed and we'll use elastic potential energy to thrust a plane forward!

## Activity #1: Ball experiment

First, let's get started with a quick experiment to test how energy can be transferred instead of lost!

Action: Ask the teacher/EA to put the students into groups and handout the instructions and materials to each group. Remind them that they will be measuring up to *150 cm* not 200 cm. Walk around the class and help the students walk through the following experiment:

- Using tape measure (or a meter stick), mark along the length of your papers at 10 cm intervals (label the marks from 10 cm – 150 cm)
- Attach all the pieces paper to the wall with one short side at floor level (and so on with the short sides attaching to the next piece)
- Hold your ball at 50 cm (or 0.5 meters) **If you drop the ball from this height, how high do you think it will bounce?**
- Drop the ball and check to see how high it bounced
- Design a chart to record the drop heights and bounce heights of: *50 cm, 100 cm,* and *150 cm*
- Assign tasks to your group members. You will need:
    - *(1) ball dropper* – to carefully drop the ball without using any force, from exactly the height recorded
    - *(1 – 2) watchers* – to watch the height of the bounce
    - *(1) recorder* – to write the information on your chart

  (Note: if there is time the groups may repeat the experiment, exchanging tasks, or using different types of balls)
- Complete the experiment by dropping the ball from the various heights and recording your results

Thinking back to your experiment, **When did the ball have potential energy?** [the ball has potential energy when it is being held, ready to drop]. **When did the ball have kinetic energy?** [the ball has kinetic energy from the moment it is let go].

**How did the ball gain energy?** [Some energy is transferred from the person holding the ball, to the ball, when they raise the ball up before it is dropped. The potential energy becomes kinetic energy once the ball is let go. The higher the ball, the greater the potential energy, and therefore, the more kinetic energy the ball has].

**Was the ball height the same as the drop height?** [No, some of the energy is used for other things].

**How many forms of energy did you notice during the experiment?** [Sound energy can be heard as the ball hits the floor; heat energy is due to friction with the air molecules against the ball as it falls; energy is used to return the ball to its original shape after the drop].

**Which type of ball that you tested bounce the highest?** [Answers will vary].

**Activity #2: Planes**

Now let's see what happens with the potential energy of an elastic as it gets transformed to kinetic energy when we let go of a paper plane!

**Safety:**

Please be careful when you go to start launching you're planes. *Do not* launch them towards anyone. I will be calling groups forward, one at a time, to launch your gliders.

Action: Hand out the elastics/rubber bands, tape, straws, paper clips, and paper triangles to get the students started on their planes.
Instruct the students through the following steps:

- Fold back the top 3 cm of the straw and insert the rubber band into the fold
- Fold the straw over the rubber band and secure the end with tape (this creates the launcher for the plane).
- Put the paperclip on 1 corner of the paper triangle (this corner will be the one that aligns with the launcher – where the elastic is).
- Have them tape the triangle to the launcher, leaving a little of the straw sticking out. (Note: you can find an example of this in the kit)
- Hook the rubber band around the tip of your thumb or finger and pull back on the opposite end of the glider/plane.
- Release the straw and the plane will fly forward (be careful of your thumb as it launches)

For this activity you should designate a launch starting line and ask that the student not cross the line when launches are happening.

Action: When there is 5-7 minutes left in the class, have them sit back down.

### Wrap-Up

**When do you think the plane had potential energy?** [when you pulled the elastic back].
**When do you think the plane had kinetic energy?** [when it flies/moves].
**What was the other way you raised the potential energy of an object today?** [when they lifted the ball before they dropped it].

**Does anybody have any questions?**

***NB**: If you have extra time, you can ask if they have any questions about university or being a student or about your research.*

Thank you for having us in your class today!

### Clean-Up

- Clean up quickly. Classroom is cleaned first. If the kit needs to be cleaned up, do it outside the classroom after the activity is completed or at some point before you bring it back to the coordinator (e.g. discard any garbage including used food like bananas, etc.)
- Try to leave the space the same as when you arrived. Be sure you have all supplies that belong to Let's Talk Science with you when you leave.
- When you return the kit bag, let the kit coordinator know if there are any supplies that are broken or missing.

## Additional Information

### Background Info

No extra background is needed to do this activity.

### WHMIS Sheets

N/A