Physical vs Chemical Changes

Grade 5

A FACILITATOR'S GUIDE

Photo

Developed by Sue McKee 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.

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:**
    - Remind students not to eat or drink anything in the experiments or to eat and drink while doing experiments. Also they are not to touch the liquids and then touch their eyes – this would be for the vinegar as it will sting their eyes. Alka Seltzer (the tablet) contains aspirin which can be harmful to children under 12.

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. There is a SDS sheet for Alka Seltzer at the end of this document.

Overview of the Workshop

Grade Level and Curriculum Learning

Grade 5: *Matter that changes state is still the same matter. Physical change refers to the fact that a substance can be changed from one form to another. Chemical change implies the formation of a new substance*.

Materials if dropping off at a school (per student unless otherwise noted). If students can work in groups, you could do 1 set for each pair of students instead of individuals.

1 baggie with ~2 teaspoons of baking soda (Powder "A")
1 baggie with ~2 teaspoons of baking powder (Powder "B")
1 baggie with ~2 teaspoons of corn starch (Powder "C")
1 Alka seltzer tablet broken into 2 ("Tablet")
Recording sheet and instructions on how to set up the experiment
8 labeled cups per individual or pair of students. These cups have a line about ½ inch from the bottom and are labelled *AA, AB*, *AC*), *"A – Tablet, BA, BB, BC,* and *B – Tablet*
2 extra plastic cups – one labelled A and one labelled B

For the teacher

1 full container of vinegar (for the teacher to distribute) – this has to be enough for each student or pair of students to have about ½ a cup each
1 film canister with tight fitting lid – the ones where the lid fits inside the canister (for the teacher)
2 tsp baking powder in a separate bag for the teacher
1 spoon
Safety goggles – one pair if the teacher doesn't have these already
Large pie plate for catching the rocket liquid

Materials if not dropping off at a school

~2 teaspoons of baking soda (Powder "A")
~2 teaspoons of baking powder (Powder "B")
~2 teaspoons of corn starch (Powder "C")
Optional: an Alka Seltzer tablet or some powder antacid like Eno
1 spoon
If possible have them ask a parent or sibling to put these into small bowls or containers and label them A, B, and C but not tell them which is which. If they know which is which, that is okay too.
Recording sheet and instructions on how to set up the experiment (or the teacher can have them draw a recording table and you can instruct them how to do the experiment)
They need some cups or bowls – something transparent preferably. Ideally they would have 8 of these but if they have fewer they can make their observations and then dump out the liquid and do a quick rinse of their cups at home. They wouldn't dump the C one down the drain – it should be put in the compost or garbage.
About a ½ cup of vinegar and a 2nd ½ cup of water
Video of elephant toothpaste

Timing of the Workshop

	Approx. Time (minutes)	Description
Introduction	5-7	Introduce yourself, find out what they already know, add in bits to fit with the curriculum learning
Physical vs Chemical Change experiments	25-35	Students run the experiments, make observations, record results, and develop conclusions.
Wrap up (elephant toothpaste video)	5-10	Play the video and follow up with questions about which parts were chemical and which were physical.

Activity

Note: *The* ***questions*** *you might ask are in* ***bolded blue font****. 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
If at a school, ask the teacher to put water in the set of cups labelled "Liquid A" and vinegar in the set of cups labelled "Liquid B" so these are ready to hand out once the introduction is complete.

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 do some experiments that are in the field of chemistry.
What is chemistry? [taking two or more chemicals/things, mixing them together, and making something new].

Ask the teacher if she/he can pick students to answer questions as you ask them. Also, you might not be able to hear the answers so the teacher might have to repeat the answers. If you cannot see the students because the camera doesn't extend to where they can see you on a screen, you'll have to rely on the teacher to know if the students are ready for the next step.

The experiments we are doing today may have physical changes or they may have chemical changes. Before we start, we need to look at what are some indicators of physical and chemical changes.

Ask the teacher if she/he can write some of these on the board as the students say them. Maybe make a chart with one side with things that indicate a chemical change may have occurred and the other side with things that are indicators of a physical change.
If the students are at home, you could ask the students to write these on a piece of paper or in a word or google classroom doc. This way they have them to refer to as they do the experiments.

What is a physical change? [a change of form of something but that something is still the same; e.g. frozen water, liquid water, and water vapour are all still H2O]

What are some words that you might use to describe a physical change? [cutting, breaking, boiling, melting, dissolving].

(Note: you might get some answers that fit with both so ask the teacher to put them under both and explain why they fit under both e.g. bubbles, often indicate a chemical change but boiling water gives bubbles that are still water so only a physical change; seeing a colour change (food colouring and water is still just food colouring and water), but a colour change is also indicative of a chemical change)

What is a chemical change? [when two or more things are mixed and make something new]

If I mix sugar and water together, I still have sugar and water in the cup. I can evaporate the water and the sugar will remain in the cup. However, if I mix acetic acid (vinegar) and sodium bicarbonate (baking soda), we get carbon dioxide gas and have made something new and the vinegar is no longer vinegar and baking soda no longer baking soda.]

What are some words that you might use to describe a chemical change? [formation of bubbles (gas), colour or odour change (like rotting meat), a precipitate forms (e.g. DNA is extracted this way), heat is released (if you've seen videos of elephant's toothpaste, heat is released or felt when the reaction occurs) or absorbed, burning, rusting].

It's common for people to say a chemical change is one where it can't be put back to how it was when you started. However, 'not being able to get something back to the way it was' doesn't always mean a chemical change has occurred – e.g. if I drop a light bulb, putting it back together would be very difficult, but dropping a lightbulb is a physical change. Popping popcorn is another physical change – it's still corn after but making popcorn look like a corn kernel again would be difficult or not possible.

Activity: Physical vs Chemical Change Experiments

Now, let's get started on some experiments.

Safety: DO NOT TASTE THE TABLET or any of the other liquids or solids – we are not using our sense of taste today. You can smell (show them how to waft to smell), touch, see, and listen today with these experiments but do not put anything in your mouth and do not eat or drink other foods during the experiments.

Ask the teacher to hand out the instructions and recording sheet and have the students start reading the instruction sheet while she/he distributes the rest of the materials: the liquid A and B cups to each student or pair of students (if they can work together) as well as the 8 labelled cups, 3 bags of powders, baggie with the tablet, and spoon to each student or pair of students.

After the students have read the instructions show them how to set up the experiment with liquid A – just do a quick talk about it so they know to set out the 4 cups with "A" at the start and use liquid A. Then let them try to use the instructions to do the rest.

Student's Procedure:

Experiment

1. Start with the set of cups labelled: *"AA", "AB", "AC"*, and *"A – Tablet"*.
2. Add *"Liquid A"* up to the line on each cup.
3. Add 1 teaspoon (doesn't have to be an exact measurement) of *"Powder A"* to cup "AA".
4. Observe what happens and record it (write it down) in the correct column in the table. Based on your observations, predict whether there has been a chemical or physical change (or both) and why you think this.
5. Add 1 teaspoon of *"Powder B"* to cup "AB".

6. Observe what happens and record it (write it down) in the correct column in the table. Based on your observations, predict whether there has been a chemical or physical change (or both) and why you think this.
7. Add 1 teaspoon of *"Powder C"* to cup "AC".
8. Observe what happens and record it (write it down) in the correct column in the table. Based on your observations, predict whether there has been a chemical or physical change (or both) and why you think this.
9. Put ½ the *"Tablet"* into the cup labelled *"A – Tablet"*.
10. Observe what happens and record it (write it down) in the correct column in the table. Based on your observations, predict whether there has been a chemical or physical change (or both) and why you think this.
11. Repeat this procedure with Liquid B and the cups that start with B.

Follow up with some questions. If this was done at a school they will have used all 3 powders and the tablet. If they are at home they might not have had all the powders or the tablet so tailor it as needed.

Did you figure out what *"Liquid A" is*? [water]. **How do you know?** [clear, colourless, odorless]

What is *"Liquid B"*? [vinegar]. **How do you know?** [smell, clear, colourless]

What were the properties of *"Powder A"*? [soft, white powder]. **Based on your experiments with water and vinegar, can you guess what *"Powder A" is*?** [baking soda because there was a chemical reaction, saw bubbles, with vinegar, but no reaction with water]. **Does anyone know what the bubbles made are?** [carbon dioxide]

What were the properties of *"Powder B"*? [soft, white powder**]. Based on your experiments with water and vinegar, can you guess what *"Powder B" is*?** [baking powder because there was a chemical reaction, saw bubbles, with both water and vinegar. Baking powder has an acid in it so it has a chemical reaction with both water and vinegar. Baking soda doesn't have an acid in it but needs an acid to have the chemical reaction. Both produce carbon dioxide gas.]

What were the properties of *"Powder C"*? [soft, white-yellow powder]. **Based on your experiments with water and vinegar, can you guess what *"Powder C" is*?** [corn starch. It just looks like goop in the water and vinegar – no chemical change occurs; cornstarch is a polymer].

What were the properties of the *"Tablet"*? [hard, round, solid]. **Based on your experiments with water and vinegar, can you guess what *the Tablet is*?** [Alka seltzer]. **Did you see any indicators of a chemical change when you did the experiment?** [yes, bubbles]. When you are older, your digestive system doesn't always work as well as when you are younger and you get indigestion sometimes which can be caused by excess acid in your stomach. Alka seltzer has baking soda in it and helps to neutralize the acid so your stomach feels better. It also has aspirin in it which helps take away any pain.

Wrap-Up

Now we've seen a few experiments where there was a chemical change and some where there was no chemical change.

If you are doing the activity with a school, you can walk the teacher through how to make a film canister rocket as below. There are 2 ways the teacher can make the film canister rocket – with the lid facing up toward the ceiling or with the lid facing toward the floor. The 'bang' is bigger if the lid is facing toward the floor but it can also make a bit of liquid mess outside the pie plate.

Ask the teacher to get out the pie pan, the baggie with baking powder in it, the film canister, and to get a bit of water (roughly enough to fill the film canister to about ¾ full). Ask the teacher to put on safety glasses (or if he/she wears glasses, that will be fine).

Have the teacher put the pie plate on the floor in the classroom, away from where students are sitting and away from lights in the ceiling (because the canister will shoot toward the ceiling). Ask the students, based on their experiments, what will happen if the teacher adds a bit of baking powder and water to the canister and then puts the lid on and why they think this will happen (you'll get various answers, but someone should say there is a chemical reaction/change taking place that produces a gas and the pressure from the gas should cause the lid to pop off). Have the teacher make the rocket by putting about a ½ a teaspoon of baking powder in the canister, then adding water to about ¾ full (make sure the teacher has the lid ready to go on as they need to get it on tight asap after adding the water). Add the lid and give it a quick shake. Then place it in the pie pan either lid up or lid down. Stand back.

If you are doing the activity with students schooling from home do this instead:
I'm not sure you've heard of it before, but there is a pretty cool experiment called elephant toothpaste. We can't do it in your classroom but we have some volunteers who made a video of it. While you watch it, think about which parts are a physical change and which ones are chemical changes and why.

Does anybody have any questions?

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

- The teacher keeps everything, but let her/him know not to put the cornstarch down the sink.

Additional Information

Background Information

The following pages include the "Student's Instructions" handout for the experiments, and their recording table and questions for the activity.

Student's Procedure (DO NOT TASTE the TABLET)

Procedure:

1. Start with the set of cups labelled: *"AA", "AB", "AC"*, and *"A – Tablet"*.
2. Add *"Liquid A"* up to the line on each cup.
3. Add 1 teaspoon (doesn't have to be an exact measurement) of *"Powder A"* to cup "AA".
4. Observe what happens and record it (write it down) in the correct column in the table. Based on your observations, predict whether there has been a chemical or physical change (or both) and why you think this.
5. Add 1 teaspoon of *"Powder B"* to cup "AB".
6. Observe what happens and record it (write it down) in the correct column in the table. Based on your observations, predict whether there has been a chemical or physical change (or both) and why you think this.
7. Add 1 teaspoon of *"Powder C"* to cup "AC".
8. Observe what happens and record it (write it down) in the correct column in the table. Based on your observations, predict whether there has been a chemical or physical change (or both) and why you think this.
9. Put ½ the *"Tablet"* into the cup labelled *"A – Tablet"*.
10. Observe what happens and record it (write it down) in the correct column in the table. Based on your observations, predict whether there has been a chemical or physical change (or both) and why you think this.
11. Repeat this procedure with Liquid B and the cups that start with B.

Table for Recording Observations and Results & Discussion questions

Matter used	Observations	Chemical reaction	Physical change	Both a chemical reaction and physical change
Liquid A/ Powder A				
Liquid A/ Powder B				
Liquid A/ Powder C				
Liquid A/ Tablet				
Liquid B/ Powder A				
Liquid B/ Powder B				
Liquid B/ Powder C				
Liquid B/ Tablet				

WHMIS Sheets

Chemwatch: 26561

Chemwatch Hazard Alert Code: 1

MINI SDS

Bayer Alka-Seltzer Effervescent Tablets

INGREDIENTS	CAS NO	%	8HR OEL

GHS

Not Applicable

DG

UN No: **Not Applicable**
DG Class: **Not Applicable**
Subsidiary Risk: **Not Applicable**
Packing Group: **Not Applicable**

HEALTH HAZARD INFORMATION

Signal word:	
Hazard statement(s):	Not Available

PRECAUTIONS FOR USE

Glasses:	Consider chemical goggles.
Gloves:	General purpose rubber glove. PVC chemical resistant type.
Storage and Transportation:	Store in cool, dry, protected area.

PROPERTIES

Mixes with water.

EMERGENCY

FIRST AID

Swallowed:	Give water (if conscious). Seek medical advice.
Skin:	Remove contaminated clothing. Wash with soap & water.
Inhaled:	Fresh air. Rest, keep warm. If breath shallow, give oxygen. Medical attention.
Advice To Doctor:	Treat symptomatically.
Fire Fighting:	Water spray/ fog. No restrictions on extinguisher type.
Spills and Disposal:	Sweep shovel to safe place.

SAFE STORAGE WITH OTHER CLASSIFIED CHEMICALS

x — *Must not be stored together*
0 — *May be stored together with specific preventions*
+ — *May be stored together*

Chemwatch: 26561
Print Date: 18/10/2020
Issue Date: 01/11/2019