ACTIVITY 6

IS THERE IRON IN MY CEREAL?

EXPERIMENT OBJECTIVES AND CONTENT

In this activity, students learn about "Nutrition Facts" tables, certain aspects of good nutrition and the importance of iron in the human body.

CAUTION: CHECK TO SEE IF THERE ARE ANY STUDENTS WITH FOOD ALLERGIES.

ESSENTIAL KNOWLEDGE

MATERIAL WORLD

Matter:
- Magnets (uses)
- Properties and characteristics of matter in different states
- Changes in matter: physical changes
- Changes in matter: chemical changes

Appropriate language:
- Terminology related to an understanding of the material world

LIVING THINGS

Energy:
- Sources of energy for living things: nutrition for animals (minerals)
- Agricultural and food technologies

Appropriate language:
- Terminology related to an understanding of living things

SUGGESTED MATERIALS

Scientific equipment:
- Beakers or measuring cups
- Blender or mixer
- Strong magnets (ideally neodymium magnets)

Optional scientific equipment:
- Mortar and pestle
- High-resolution portable microscope (Proscope)
- Magnifying glass or microscope

Perishable non-scientific materials:
- Breakfast cereals with an iron content equivalent to at least 60 percent of the recommended daily amount (e.g., certain baby cereals, muesli etc.)
- Plastic spoons

CONTEXT: SITUATIONAL PROBLEM OR RESEARCH QUESTION

At one time or another, your parents have probably insisted that you eat something you didn't like very much because it was good for you. Perhaps they even said it was good for you because it was full of iron, like liver, for example. Have you ever noticed that iron is listed on the Nutrition Facts tables of some foods? How can we extract and see this iron?

SUGGESTED PREPARATORY ACTIVITIES (INTRODUCTION)

The teacher could ask students to bring Nutrition Facts tables to class. The students examine them and share what they find. On the board, list the nutritional items that appear frequently, those that the students don't know, etc. It would also be important to cover the concept of percentage so that the students understand that the percentage listed indicates the item's contribution to the recommended daily amount. One way to introduce this concept would be to ask the students, "if the label indicates 'Iron: 60%', does this mean that more than half the item is made up of iron?" You could also make a connection with *Canada's Food Guide*.

INITIAL IDEAS AND HYPOTHESES

Here are a few examples of hypotheses the students might formulate based on their initial ideas:

Example 1
I predict that I will see iron if I put some cereal in water and I see rust appear. I predict this because I know that iron rusts, and that I can accelerate the reaction by putting the iron in contact with water.

Example 2
I predict that I will not be able to see the iron. I predict this because we cannot eat metals, and the iron in cereals is not the same kind of iron that you find in a nail.

Example 3
I predict that I will see iron if I grind or crush the cereal. I predict this because I know that cereal contains iron, but we can't see it when the cereal is whole. So if I break it into smaller pieces, I think I will be able to see small particles of iron contained in the cereal.

Example 4
I predict that I will be able to detect iron with a magnet. I predict this because I know that magnets attract iron. I know this because I can attract nails with a magnet but not books or pieces of fruit.

WORK PLAN AND EXPERIMENTATION

Here are a few examples of experiments the students can carry out to verify their hypotheses:

Example A
The students place some ground up cereal in a clear container that contains salt or vinegar water and observe whether rust appears.

Note: Salt water or water acidified with vinegar will accelerate iron oxidation. However, it may be difficult to see the rust because it has an orange color, much like the cereal itself. Moreover, the amount of iron is so small that it will be hard to detect with the naked eye. If you have a digital microscope (Proscope), it could be useful. A magnifying glass or a conventional microscope will also do the trick.

RECORD ALL YOUR IDEAS AND OBSERVATIONS IN YOUR EXPERIMENT WORKBOOK.

Example B
One must use a method even to prove the absence of something. The students could use one of the protocols in this section with, in this case, the hypothesis that they will not find any iron. The hypothesis will prove to be false at the end of the experiment, but from a scientific and learning standpoint, this is just as valid a result.

Example C
The students grind up some cereal and try to observe the presence of iron using a magnifying glass or microscope. They could use a magnet to confirm whether or not something is iron.

Example D
The students crush some cereal into very fine particles (with a mortar and pestle, for example) and use a magnet to try and remove the iron.

Note: It may be very difficult to see the iron, since it is made up of very fine particles.

Example E
The students place 50 to 100 ml of cereal in a beaker. They then add 150 to 200 ml of hot water, let the mixture soak for one minute, blend it in a mixer for 30 seconds at the highest setting, and pour it back into the beaker. Finally, they move a neodymium magnet slowly and methodically around the outside of the beaker. The iron will become visible on the beaker wall opposite the magnet. If the mixture separates (the cereal will have a tendency to float), stir it with a spoon to make it more uniform. They can bring the iron to the top of the liquid to see it more clearly by drawing the magnet up and over the line of the liquid. They will also be able to see the particles of iron align in the magnet's magnetic field if they move it slightly.

Note: This is the protocol that provides the most convincing answer.

EXPERIMENTAL FACTORS
To ensure scientific rigor, the students should evaluate the experimental factors that might influence the experimental results.

- Amount of cereal
- Type of cereal used (percentage of iron)
- Amount and temperature of water
- Strength of magnet
- Force of observational instruments (naked eye, magnifying glass, microscope)
- Fineness of particles achieved by crushing

DISCUSSION: SUGGESTED INTEGRATION ACTIVITIES (CONSOLIDATION)

The teacher leads a discussion with the whole class to pool everyone's observations and results. Did the students see any iron? How did they do so? What descriptions can they make? If their experiment was not conclusive, can they determine why? Each team shares the results of its experiment with the class.

SUGGESTED ACTIVITIES FOR APPLYING KNOWLEDGE (APPLICATION)

It might be interesting for students to experiment with the other suggested protocols. Their observations will likely lead to questions such as, "Why does our body need iron?" At this point, you can either answer the questions directly or point them to other sources of information such as the Internet. However, it would be important to explore with them the role of iron in the human body.

SCIENTIFIC CONCEPTUAL CONTENT

Iron and nutrition
The small amounts of iron in the food we eat is pure iron, i.e., it is the same iron found in objects such as nails. Iron is an element of the periodic table. It plays a vital role in human nutrition. It nourishes the hemoglobin in red blood cells. Hemoglobin is what carries oxygen throughout the body, but it cannot move by itself and therefore requires a vehicle –red blood cells–to move through the body. If the number or quality of red blood cells in the body decreases, oxygen circulates poorly, and this may cause anemia.

Anemia
A blood condition characterized by a reduction in the number and quality of red blood cells. This reduction causes poor oxygen transport in the body. The primary symptoms of this illness are paleness, fatigue, a sensation of weakness, shortness of breath, and a higher heart rate.

Iron deficiency
Iron deficiency can occur when the body loses a significant amount of blood. This most commonly happens through hemorrhages due to injuries, childbirth or heavy menstrual bleeding. In general, women and children have lower levels of hemoglobin and red blood cells than men. Premature or low birthweight babies may also suffer from iron deficiency. It can be treated with liquid or solid iron supplements. This is why after childbirth, women who have lost a lot of blood are given iron supplement injections to help them recover. Newborns are also given liquid iron supplements orally. Many iron-enriched breakfast cereals and baby cereals, like the ones you used in your experiments, are also excellent sources of iron.

Red blood cells
Disc-shaped biconcave cells lacking a nucleus and containing a large amount of hemoglobin, which is what confers a red coloration. The hemoglobin in these cells transports oxygen from the lungs to every cell in the body and transports some carbon dioxide from the cells to the lungs. Glucose is the only source of energy used by red blood cells.

Hemoglobin
The red-colored protein in red blood cells that gives them the ability to transport oxygen throughout the body.

Iron and magnets

One characteristic of magnets is that they attract certain ferromagnetic metals. Only three materials are attracted by magnets: iron, nickel and cobalt.

Iron in the body

There is an average of 4 grams of iron in the body of a man and 2.5 grams in the body of a woman. The body cannot synthesize iron itself, so it must acquire it through food. Iron is found in meats and plant-based foods.

Once iron is absorbed by the intestine, it moves into the blood, where it nourishes hemoglobin, which in turn nourishes red blood cells. Together, they transport oxygen throughout the body. Hence a kind of chain reaction occurs: the body takes in iron from food, the iron nourishes hemoglobin, the hemoglobin nourishes red blood cells, and the red blood cells provide the body with oxygen.

In cases of iron deficiency, the body has fewer red blood cells and they are a lighter shade of red because they contain less hemoglobin. As a result, they have a lower capacity to transport oxygen, and anemia occurs.

CULTURAL REFERENCES

Canada's Food Guide

The first Canadian food guide, published in July 1942, was entitled Canada's Official Food Rules and was aimed at preventing nutritional deficiencies and improving the health of Canadians faced with wartime rationing. Over time, the guide has undergone many changes, but its goal has remained the same: to orient Canadians' food choices and promote healthy nutrition.

It should be noted that the guide's recommendations are based on the most up-to-date scientific understanding of nutrition and are backed up by data linking nutrition to risk reduction for chronic diseases.

Nutrition Facts table

In 2007, nutritional labeling was made mandatory on all prepackaged foods. The Nutrition Facts table is presented the same way on all food labels to make it easier to find and read.

Enriched foods

In Canada, with very few exceptions, food manufacturers can add vitamins and minerals (a process called "enrichment") to most foods according to policies set out by Health Canada that establish quantitative limits. These policies are a way to ensure that Canadians receive the nutrients they need without being exposed to dangerously high levels.

Nutrition month

Every March is Nutrition Month. Thousands of dieticians work throughout the country to offer tips and advice about healthy lifestyle habits and nutrition.

FOR MORE CULTURAL REFERENCES, VISIT THE ÉCLAIRS DE SCIENCES WEBSITE:

www.eclairsdesciences.qc.ca

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Conception
Les Neurones Atomiques

Find out more about the educational activities and other resources offered by this organization on their website: **www.lesneuronesatomiques.com**

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PROCESS OF ACTIVE DISCOVERY

GENERAL LEARNING PROCESS IN SCIENCE AND TECHNOLOGY (IN ELEMENTARY SCHOOL)

Context related to everyday life

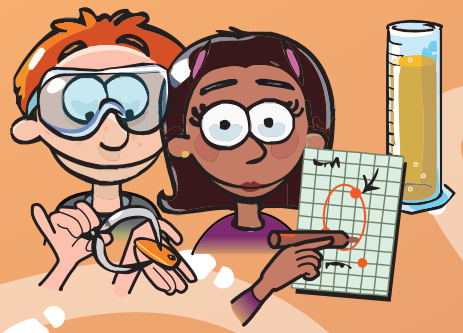
- **Situation problem** or
- **Discovery question** or
- **Need to be fulfilled**
- **Question related to the operation of an object** (how does it work?)

Initial ideas and hypothesis

My initial ideas:
- I share my own ideas.

My hypothesis:
- I predict that... I think that because…
- I imagine my prototype.
- I think it works like this…

Planning and carrying out



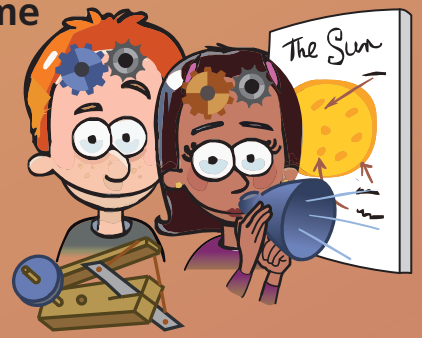
My equipment:
- I observe and handle the equipment.
- How could this equipment be useful to me?
- I choose my equipment and my materials.

Carrying out my process:
- What will the steps be?
- What precautions should I take?

My actions:
- I carry out the steps of my protocol.
- I note or draw what I observe, what I do and what I discover.

My results:
- What is my answer to the problem, question or need?

Outcome



My outcome:
- Do my results confirm my hypothesis or not?
- Are my results similar to those of the other teams?
- Can the other teams' results help me to find answers to my problem, my question or my initial need?
- What could I communicate concerning my discoveries?

New question?

What I learned:
- What do I retain from this activity?
- What could I communicate concerning my results or my discoveries?

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