ACTIVITY 1

WHICH LIQUIDS MIX TOGETHER AND WHICH DO NOT?

EXPERIMENT OBJECTIVES AND CONTENT

In this activity, students learn that some liquids do not mix together as well as others, and that it is possible to create layers of liquids.

ESSENTIAL KNOWLEDGE

- Mixtures: miscible and nonmiscible substances

SUGGESTED MATERIALS

Scientific equipment:
- Beakers
- Droppers
- Graduated cylinders
- Scales

Perishable non-scientific materials:
- Water
- Vegetable oil
- Vinegar
- Corn syrup
- Fruit juice
- Different liquids
  (soft drinks, chocolate syrup, molasses, dish soap, fabric softener, milk, cold coffee, etc.)

Household materials:
- Food coloring
- Clear jars with lids
- Small plastic plates
- Metal spoons
- Measuring spoons
- Funnels
- Toothpicks

CONTEXT: SITUATIONAL PROBLEM OR RESEARCH QUESTION

You and your big sister decide to surprise your parents by making them breakfast. While making pancake batter, you notice that milk and water mix together well, but when you add oil, it stays separate and forms small globules. Why? You decide to see how other liquids mix together.

SUGGESTED PREPARATORY ACTIVITIES (INTRODUCTION)

Before beginning, we suggest you lead a discussion to help the students grasp the difference between different states of matter: solid, liquid and gas (see scientific concepts). The teacher asks the students to bring a liquid of their choice from home. In class, the students look at all the liquids, observing their appearance, consistency, color, transparency, odor, etc.

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 oil and vinegar will not mix. I predict this because when you put vinaigrette in the refrigerator, the oil always ends up on top of the vinegar.

Example 2
I predict that water and juice will mix easily. I predict this because when I make juice from frozen concentrate, I am able to easily mix the concentrate with water.

Example 3
I predict that corn syrup and water will not mix. I predict this because corn syrup is thicker and heavier than water. So the syrup will end up on the bottom and the water on top.

Example 4
I predict that when I gently pour different liquids into a jar, the liquid I pour in first will end up at the bottom of the jar, the second in the middle, and the third on top. I predict this because I think that is how you make three-colored popsicles.

WORK PLAN AND EXPERIMENTATION

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

Example A
Using a graduated cylinder, the students measure out an amount of oil and pour it gently into a jar. Then they tilt the jar slightly and pour the same amount of vinegar gently onto the side of the jar, so that the two liquids do not mix. They observe what happens. They could also do the same experiment but reverse the order in which they pour the liquids. To verify whether or not the two liquids are miscible, they can seal the jar, shake it up and observe how the liquids behave.

Note: To compare how different combinations of liquids react, the students could fill in a pre-made table with descriptive icons.

RECORD ALL YOUR IDEAS AND OBSERVATIONS IN YOUR EXPERIMENT WORKBOOK.

Example B
The students use droppers to place a drop of juice and a drop of water beside each other on a plate. They next take a tooth pick and move one of the drops toward the other, observing how they mix together. Another option would be to place the drop of juice directly onto the drop of water and observe whether or not it is possible to mix them.

Example C
The students pour a measured amount of corn syrup into a beaker; then, without shaking the liquids, gently add the same amount of water and observe what happens. To reduce the force of impact of the water on the syrup, they can pour the water over the back of a spoon. They could also shake the contents of the beaker to observe how the liquids react.

Example D
The students predict the order in which oil, water and corn syrup will form layers when poured in a particular order. They make sure they use the same amount of each liquid. They can then try and pour the same liquids in a different order to see if they will react differently.

Note: If the vegetable oil used is colorless, food coloring can be added to the water to make it easier to see the different layers.

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

- Method used to mix the liquids
- Order in which liquids are poured
- Amount of each liquid used
- Liquid density
- Hydrophobic or hydrophilic nature of the liquids used

WARNING: TEACHERS SHOULD ENSURE THAT STUDENTS BRING ONLY NON-TOXIC LIQUIDS TO CLASS.

DISCUSSION: SUGGESTED INTEGRATION ACTIVITIES (CONSOLIDATION)

The teacher draws a grid on the board to summarize the combinations of liquids studied. Each team writes its results on the board. The grid can be divided as follows: in the first column, write the names of the liquids (words or icons); in the second column, write the order of the liquids used; and in the third column, indicate whether the liquids are miscible or nonmiscible.

The students can use icons symbolizing the results obtained. Hence, an image of a beaker containing a green liquid might indicate that the liquids mixed, while an image of a beaker half-filled with yellow liquid and half-filled with blue liquid might indicate that the liquids did not mix.

By weighing equal volumes of different liquids, the students can verify if the order of superposition of the liquids corresponds to their classification by weight. In this way, the teacher can help the students understand that a liquid's miscibility does not depend on its density (or mass per unit of volume) but instead on is hydrophobic or hydrophilic nature.

SUGGESTED ACTIVITIES FOR APPLYING KNOWLEDGE (APPLICATION)

The students could create a large-scale "snakes and ladders" type of game. Instead of using a dice to move the game pieces, the students answer questions about the miscibility of liquids. Each student writes a question and finds the answer. The teacher then validates the questions and answers. A tournament between different classes could be organized.

SCIENTIFIC CONCEPTUAL CONTENT

States of matter
Everything around us is made up of matter, which can take different forms: solid, liquid or gas. For example, ice is simply water in a solid state. Water flows from the tap in a liquid state. Finally, the steam that comes out of a kettle is water in a gaseous state.

Miscible and nonmiscible
When liquids mix into a new homogenous body, such as vinegar and water, they are said to be miscible. When the liquids that are put together stay separate, or separate after a certain amount of time, they are said to be nonmiscible. Such combinations, for example oil and vinegar, always form heterogeneous mixtures in which the initial liquids can be distinguished.

Emulsion
An emulsion is a mixture of two nonmiscible substances in which one of the two is suspended in the other in the form of tiny droplets. A vinaigrette that has been shaken up is an example of an emulsion. Milk is a natural emulsion in which tiny droplets of fat are in suspension.

Hydrophobic and hydrophilic
In Greek, hydro means "water" and phóbos means "fear." So a hydrophobic substance is one that "does not like water" and is not soluble in water. However, it will mix very well with fatty substances. Hydrophilic substances, those that "like water," are soluble in water but not in fatty substances.

Density
This is the mass (or weight) of a substance for a given volume. For example, pure water has a density of 1 g/ml because 1 millilitre of water weighs 1 gram. A liquid with a density greater than that of water is therefore heavier than water, and when mixed with water, it will sink to the bottom of the jar (e.g., corn syrup has a density of 1.5 g/ml). On the other hand, a liquid with a density less than that of water will float above water when mixed with it (e.g., vegetable oil has a density of 0.9 g/ml). To calculate density, simply measure a precise volume of liquid and weigh it, then convert the values to grams per millilitre.

Order of layers formed by liquids
Regardless of what order liquids are poured into a container, if they are poured in gently enough so that they do not mix, they will always form layers in the same order, based on their density. For example, corn syrup will end up on the bottom, then water, and finally vegetable oil on top.

CULTURAL REFERENCES

Lava lamp

This type of lamp is a perfect example of the principles of the miscibility and density of liquids. These decorative lamps are generally made up of a hydrophilic liquid and a colored wax (hydrophobic). The wax bubbles rise and fall according to their density, which changes depending on the temperature. When the lamp is turned off, the wax cools and becomes heavier than the liquid, falling to the bottom of the lamp. When the lamp is turned on, the light bulb at the base of the lamp heats the wax and melts it. As the wax warms it becomes less dense (and therefore lighter) than the liquid and rises to the top of the lamp. As the wax rises and moves farther from the light bulb, it cools, becomes heavier and falls back to the bottom. And the cycle starts over again. The lamp was invented by Edward Craven Walker and first marketed in 1963 as the Astro Light.

Oil spills

Occasionally, if the hull of a large oil tanker is ruptured or a submarine pipeline breaks, large quantities of oil are spilled into the ocean, causing great harm to the environment. Fortunately, since oil's density is lower than that of salt water, it floats on the ocean's surface, which makes it easier to collect the spilled oil and limit the harm to the ocean's plants and animals.

Person

Archimedes, a scholar of antiquity born near Syracuse in what is now Sicily around 287 BCE, was once given the task of determining whether the crown of the king of Syracuse was made entirely of gold without damaging it. Archimedes thought about the problem for days without finding a solution. Then one evening, as he got in his bathtub, the water rose so high that it spilled over onto the floor, and this gave him an idea of how to solve the problem. He simply immersed the crown in water and measured how much liquid was displaced. He did the same thing with the initial amount of gold used to make the crown and compared the two measurements. Unfortunately, the crown displaced more water, which meant that it contained another metal that was lighter than gold (in this case, silver). The king's crown was thus larger and displaced more water than it should have had it been made from pure gold. The principle of density had just been discovered and the king of Syracuse had just realized that his crown was not pure gold.

FOR MORE CULTURAL REFERENCES, VISIT THE ÉCLAIRS DE SCIENCES WEBSITE:
www.eclairsdesciences.qc.ca

REFERENCES

Caillé, André and Catherine Couture. "Module 1. Les fureteurs à la cuisine." In *Les fureteurs 2e cycle, Science et technologie, Cahier d'apprentissage A*. Montréal: Chenelière/McGraw Hill, 2000.

Challoner, Jack and Angela Wilkes. *Je réalise des expériences. L'atelier des enfants Larousse*. Paris: Larousse, 1996.

Vu sciences. "La physique." In *Dictionnaire visuel pour tous des sciences*. Paris: Gallimard Jeunesse, 2001.

La main à la pâte. "Les mélanges de liquides." In *La main à la pâte*. [Website, 2007] www.inrp.fr/lamap/?Page_Id=6&DomainScienceType_Id=11&ThemeType_Id=25&Element_Id=2. Consulted November 19, 2007.

Conception
Les Scientifines

For more information on the school activities offered by this organization, consult their website (French only) at **www.scientifines.com**

A project of

Produced by

Major financial partners

PROCESS OF ACTIVE DISCOVERY

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

Context related to everyday life

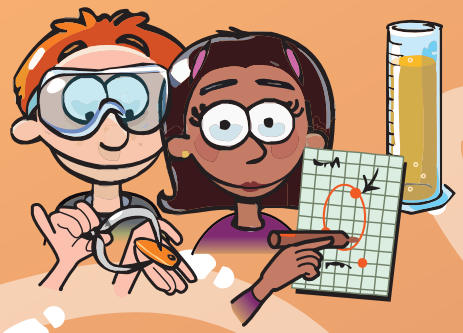
- **Situation problem** or
- **Discovery question** or
- **Need to be fulfilled**
- **Question related to the operation of an object** (how does it work?)

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



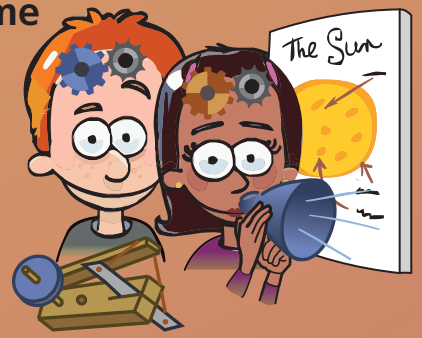
My equipment:
- I observe and handle the equipment.
- How could this equipment be useful to me?
- I choose my equipment and my materials.

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?

Éclairs de sciences
OUTILLE LE PERSONNEL DU PRIMAIRE
centre de développement pédagogique
didaclip