QUICK ENGINEERING CHALLENGE 2016

An Apple Flotation Device

Instructions for Elementary School Classes

- **Level:** Elementary 3
- **Recommended duration:** About 90 minutes, including setup and explanations
- **Teams:** Two or three participants per team

Materials

For each team

1 apple (same size and variety for all teams)

4 wooden skewers

4 long elastic bands (office type)

2 empty plastic bottles, 350 mL to 500 mL (water, juice or soft-drink bottles) with caps

2 metres of butcher's twine (cotton string)

2 large drinking straws (ideally, slushy-size)

6 wooden coffee stir-sticks

2 styrofoam trays, about 20 cm by 10 cm (the kind used in grocery stores to package meat and produce)

1 roll of tape (Scotch tape, adhesive tape, packing tape, etc.)

For the class

One or two sinks or large containers (dishpans, plastic storage boxes, aquariums, etc.), filled with 15 cm to 20 cm of water.

A timer.

The students can bring the following items from home:

- *empty plastic bottles*
- *large straws*
- *styrofoam trays*
- *roll of tape*

Suggestion: Organize the materials into complete kits ahead of time so that they can be distributed quickly to the teams.

Scenario

Teachers can explain the scenario to their students or show them the video, which is available on our website (french only):
http://www.sciencepourtous.qc.ca/24heures/24-hours-of-science

In April 1912, the *Titanic* struck an iceberg drifting in the currents of the North Atlantic. The damaged ship sank off the coast of Newfoundland. Today, the ocean currents in the Atlantic and the Gulf of St. Lawrence are better understood, and sea voyages are much less risky.

But it seems that these currents are changing. Variations in their direction and force are being detected. Is this happening because of climate change?

To find out the answer to that question, and to make sure that ships can still travel safely, a program to monitor the currents in the Gulf of St. Lawrence is on going. Hundreds of small buoys will be placed on the water at different locations in the Gulf and tracked by satellite for several months. This will give researchers detailed information about surface flow. The buoys will emit radio signals that will be detected by the satellites, so it is important that the buoys' electronic systems stay above the surface of the water.

Explaining the challenge to the students

The program needs your help in designing these buoys. They are about the same size and weight as an apple, so you'll be using an apple to carry out the challenge. The signal buoy will be built around the apple. **Your challenge is to add other components to your apple in order to build a buoy that will float on the water, without the apple touching the water.**

The apple must always remain above the water, but it does not matter whether it is right side up or upside down. If it is submerged by a wave, the apple-buoy must pop back up quickly. It does not have to right itself; it just has to float above the water again.

Rules

Design process

- Each team must be made up of two or three students.
- Once the signal is given to begin, the students will have 40 minutes to build and test their buoy (extra time may be allowed if necessary).
-Tools are allowed: for example, scissors, ruler, pencil, etc. However, they must not be used as materials.
- Announce to the students that they must complete the challenge in **40 minutes**.
- Three trials are allowed in the sink or basin of water.

What's not allowed

- Do not cut the apple into pieces or make holes in it. It's okay to insert things into it, as long as the apple stays in one piece.

- Do not enclose the apple completely in the structure. It should still be possible to pick up the buoy by holding the apple directly with your fingers. For example, don't cut open a plastic bottle and place the whole apple inside it.

Competition

Testing each team's buoy

-Gently place the buoy in the water.

-Turn it in all directions to see whether the apple always stays out of the water no matter whether the buoy is right side up, upside down, or on its side. It's okay if the apple goes under the water, but it must pop back up immediately. The buoy doesn't have to right itself, it just has to return to a position in which the apple is out of the water.

-Completing the challenge successfully means building a buoy that will enable the apple to pop back up out of the water in any situation.

> *When taking the buoys apart afterwards, place recyclable items (plastic bottles and straws) in a recycling bin and the apples in a composter.*

This challenge is an initiative of *Science pour tous*, presented in cooperation with the Conseil de développement du loisir scientifique and the Réseau CDLS-CLS as part of *24 Hours of Science*. The project is financed by the Natural Sciences and Engineering Research Council of Canada (NSERC).

Illustration : Jacques Goldstyn