

Activity 3_1: Observing convection currents

Introduction:

Have you ever tried to get your face (or hand) above an operating stove or a heater? If yes, what have you noticed in particular?

Do you think that a similar effect could also be present in a container of water which is heated from below? What might you observe?

Think about how you could create an in-class experiment to give an experimental answer to the above question and describe the experiment:

The problem:

When in a room a heater plate or stove starts operating it is possible to note a movement of air from bottom to top. This can be highlighted by means of some smoke (e.g. cigarette) blown in the vicinity of the radiator, which tends to go upwards. This is due to the temperature difference between the lower and the upper wall of the room. We now want to see what happens in a container full of water when its left and right parts are kept at different temperatures.

Material needed for each group:

- Two bowls filled of hot water and ice, respectively.
- • A small fish tank filled with water at room temperature.
- • Two small amount of red and blue dyes.

Suggestions for the experiment:

Fill one of the two containers with ice and water and the other with hot water, at about 70 ° C. Fill the fish tank at half level with water at room temperature and put it on the two containers, as shown in figure.



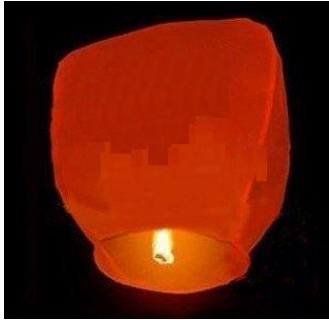
Now, pour a drop of red ink in the fish tank, on the side of the vessel with hot water and one drop of blue ink on the other side. What do you observe? Describe what happens as time flows.

Try to explain the behavior of the red and blue ink drops?
Have you already seen something similar in other real-life situations?

What physical variable might be responsible for what you have observed? (Hint: think about what water features may vary with temperature ...).

Another experiment:

The figure shows a popular toy: the "hot-air balloon".
A small candle is secured to the open end of a paper or plastic balloon. When the candle is lit the balloon begins to rise, soaring into the air.



Do you think that this phenomenon can be related to the experiment we made with water and ink or with the considerations we made for the smoke blown over a radiator?

What physical quantities are involved in this case?

Discuss your findings with your group mates. Share your conclusions with the whole class and the teacher, trying to identify the physical quantities that are more relevant for description and interpretation of the situations analyzed. Report below the conclusions to which the entire class group has come.



Explanation:



Phenomena of breezes over land masses near to large basins of water supply a relevant example of convection currents. Water has a larger heat capacity than land. As a consequence it holds thermal energy better than land and takes longer to change its temperature, either upward or downward. Thus, in the morning, due to the sun heating, the air above the water is cooler than that over the land. This creates a low pressure area over the land, with respect to the high pressure area over the water. Due to this pressure difference air is pushed from the water to the land as a blowing breeze. On the other hand, during the night water cools off more slowly than the land, and the air above the water is slightly warmer than over the land. This produces a low pressure area over the water with respect to the high pressure area over the land, and this time air is pushed from the land to the water.