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## TITLE:

STEAM aspects in a red cabbage

GRADE LEVEL: 6TH TO 9TH GRADE

STEAM AREAS: SCIENCE, ARTS,  
MATHEMATICS

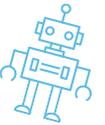
## MATERIALS NEEDED:

- A red cabbage,
- knife,
- beacher,
- bunsen or a stove,
- vinegar or lemon juice,
- sodium bicarbonate,
- water,
- drawing sheets.



## OBJECTIVES:

- Discover Science and Maths in the Nature;
- Discover example of Fibonacci spiral;
- Find out how a pH indicator works;
- Use natural dyes to make Art.



## PROCEDURE:

Red cabbage is a plant belonging to the brassicaceae family, characteristic leaves' color depends on the presence of anthocyanins. Leaves' color can be a little different according to the soil pH value: red in a acid soil, purple in a neutral soil and green in an alkaline soil.

A red cabbage allows you to make many observations and activities in the classroom. The various activities can be simplified and adapted so that they can also be done in primary school and kindergarten.

### **First activity: analyzing the aspect and the structure of a red cabbage (60 minutes)**

#### **Procedure:**

Take a red cabbage and observe its color and its leaves.

Then using a knife cut it horizontally into two parts. You can observe that the arrangement of the cut leaves follows spiral sequences. This type of spiral is known as "golden spiral" or "Fibonacci spiral" (from the name of a famous Italian mathematician). Do a little research on this type of spiral and the related sequence. Later try to reproduce the spiral in in your notebook or using tools like Geogebra. You can delve deeper into the topic by looking for other examples of golden spirals in nature and in art. Older students can have the opportunity to discover the golden ratio value.



## PROCEDURE:

### Second activity: building a pH indicator (60 minutes)

Cut the leaves of a red cabbage and boil them with a little water in a beaker.

Filter the broth obtained and let it cool.

Take some of the resulting juice and place it in 3 different beakers or other clear glass containers.

Now add a few drops of vinegar or lemon to one of these beakers and see what happens: immediately the color changes and becomes lighter and redder.

Now add a little bit of baking soda to another beaker and see what happens: the color becomes greener. (You can check the initial color by looking at the third beaker which contains only the juice).

This happens because the anthocyanins present in cabbage change color depending on the pH value. Now you can try using red cabbage juice to evaluate the pH of some substances: if the color becomes redder then the pH is acidic, if it becomes greener, then the pH is basic.

You can also soak thin strips of filter paper with this juice to make your pH meter.

### Third activity: making abstract Art (45 minutes)

Use a small paintbrush to drip tiny droplets of red cabbage juice onto a drawing pad.

You can make the droplets fall randomly or in a pattern you prefer.

You can also simply brush the juice onto the sheet.

Be careful not to let too much juice fall on the sheet, otherwise it will ruin it.

Now clean the brush and use it to drop very small drops of lemon onto the paper.

When the droplets touch the parts colored with the juice they will change the color.

This time too you can make the droplets fall randomly or according to your own pattern.

In the end you will get an abstract design with different color gradients.

## ASSESSMENT:

- Tests about pH, spirals and Fibonacci sequence;
- Reports on the activities;
- Drawings.

## REFERENCES:

- [https://en.wikipedia.org/wiki/Red\\_cabbage](https://en.wikipedia.org/wiki/Red_cabbage)
- <https://www.mathsisfun.com/numbers/fibonacci-sequence.html>
- <https://www.britannica.com/biography/Fibonacci#ref235946>
- <https://www.livescience.com/37470-fibonacci-sequence.html>