MODULE I

Lesson Plan 2

Summary

Lesson title

Creation of a weather station from recycled materials

Duration	135 minutes
Proposed student's age range	10-12

Summary of the theme

In this activity, students are asked to build a weather station using recycled materials. Working in groups of 3 to 4 students, they should create and verify the functionality of a thermometer, rain gauge, barometer, anemometer, and weather vane. At the end, each group will present their weather station to their classmates, explaining how each instrument works.

Learning outcomes

Purpose/Learning Objective

- Understand the basic principles of meteorology and the importance of recording and monitoring.
- To know the main meteorological variables and how to measure them.
- Promote the use of recycled materials to reduce environmental impact.

Intersecting objectives

- Encourage collaboration and teamwork.
- Promote environmental awareness and social responsibility.
- Raise awareness of the importance of respecting and caring for the environment.

Connection to SDGs

This theme is aligned with the following SDGs:
SDG 12 "Ensure sustainable consumption and production patterns": Target 12.5 By 2030, significantly reduce waste generation through prevention, reduction, recycling, and reuse.

SDG 13: "Climate Action"- Target 13.3. Improve education, awareness, and human and institutional capacity for climate change mitigation, adaptation, impact reduction, and early warning.

Implementation

Facilitation

- Making groups of 3-4 students to carry out this activity is advisable. The total number of students per group will depend on the materials and tools available.
- Make sure that all materials for making weather stations are available and organised.
- Use recyclable or recycled materials whenever possible.
- Double the total material needed to avoid stock-outs.
- Provide examples and clear guides or videos for each step carried out in the activity.
- Control and guide the groups during construction. Resolves all the doubts that the students may have.

Resources required

- Projector or screen.
- Permanent marker.
- Scissors.
- Hole punch.
- Silicone gun.
- Silicone.
- Tape.
- Glue.
- Colour markers.
- For the thermometer:
    - A glass bottle or jar.
    - Plasticine.
    - A transparent or translucent plastic straw.
    - Food coloring.
    - Alcohol (optional).
- For the rain gauge:
    - One 1.5 litre plastic bottle.
- For the barometer:
    - A plastic cup or glass jar.
    - A balloon.
    - Cardboard.
    - Straw or small wooden stick (for barbecue or similar).

- For the anemometer:
    - A plastic bottle.
    - Five cardboard/plastic yoghourt cups or similar.
    - Two plastic straws.
    - A pencil with an eraser.
    - A push pin.
- For the weather vane:
    - A straw or wooden stick (barbecue or similar).
    - Two plastic or paper plates.
    - Cardboard/cardboard.
    - A pencil with an eraser.
    - A push pin.
    - A piece of mud or stones/earth.

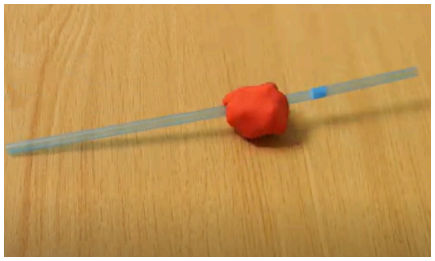
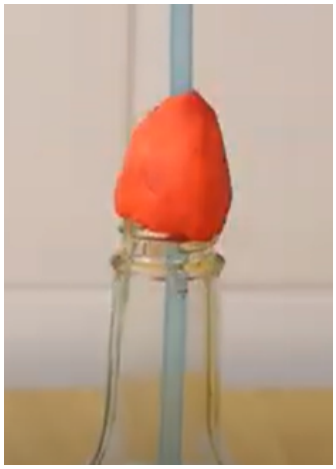
Ideas for follow-up

- From the models created, each group will be able to monitor and record daily weather data for a defined period (weeks or months).
- From the data recorded, a small report can be produced, which will include the results obtained in the form of graphs or tables.

Source / Materials & class preparation

Thermometer construction video: https://www.youtube.com/watch?v=8XskIwfddso
Rain gauge construction video: https://www.youtube.com/watch?v=Rh18GMwwV4M
Barometer construction link: https://www.wikihow.com/Make-a-Simple-Weather-Barometer
Anemometer construction video: https://www.youtube.com/watch?v=Af0LB3abBsk
Weather vane construction video: https://www.youtube.com/watch?v=jHgHcuCRXmA
Web resources on the importance of measuring meteorological parameters and how to measure them:
https://www.weather.gov/media/epz/mesonet/CWOP-WMO8.pdf
https://www.youtube.com/watch?v=p4eyhfj6gns

Lesson Outline

Timing	Instructions step-by-step
15 min.	Introduction to the topic. The teacher will explain the basic principles of meteorological instruments and the main meteorological variables recorded, as well as their importance.
10 min.	Explanation of the task and composition of the groups.
20 min.	Construction of the thermometer according to the following steps: - Take a straw and some plasticine. Mold the plasticine into a ball and place it around the top of the straw, as shown in the figure. -  *Figure 1.2.1 Place the plasticine wrapping around the straw. Source: mopatin. YouTube channel. Link: https://www.youtube.com/watch?v=8XskIwfddso* - Fill a bottle about halfway with water. Add a few drops of food colouring to tint the water. If you prefer, you can use ethyl alcohol instead of water. - Place the straw with the plasticine ball inside the bottle. Adjust the plasticine so that it completely seals the nozzle of the bottle, making sure that the inside of the bottle is as airtight as possible. -  *Figure 1.2.2 Seals the union of the straw with the bottle with the plasticine. Source: mopatin. YouTube channel. Link: https://www.youtube.com/watch?v=8XskIwfddso*

	- Make sure that the end of the straw inside the bottle does not touch the bottom, but is submerged in the water. - To test your thermometer, heat the bottle with a hairdryer or simply with your hands. You will see the liquid rise through the straw as the temperature rises.  *Figure 1.2.3 Final result of the thermometer. Source: mopatin. YouTube channel. Link: https://www.youtube.com/watch?v=8XskIwfddso*
15 min.	Construction of the rain gauge according to the following instructions: - Take a bottle and cut off the top, as shown in the figure.  *Figure 1.2.4 Cutting the top of the bottle. Source: STEAM Powered Family. YouTube channel. Link: https://www.youtube.com/watch?v=Rh18GMwwV4M* - You will be left with two parts of the bottle. Take the bottom part and, with the help of a marker pen and a ruler, make marks on the bottle every 0.5 cm from the bottom to the cut edge. If you wish, you can number the marks in ascending order from the bottom to the top edge, as shown in the figure.



Figure 1.2.5 Marking the bottle. Source: STEAM Powered Family. YouTube channel. Link: https://www.youtube.com/watch?v=Rh18GMwwV4M

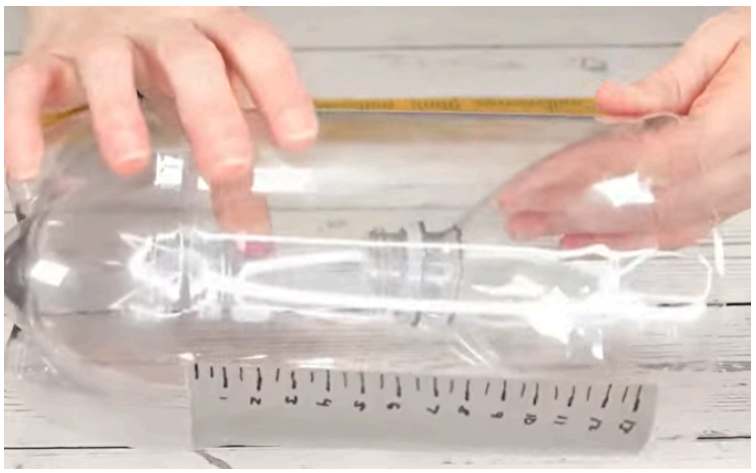
- Place the top part of the bottle, inverted, on top of the bottom part. Make sure they fit snugly and tape them together to hold them in place.
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Figure 1.2.6 Place the upper part of the bottle inside the lower part. Source: STEAM Powered Family. YouTube channel. Link: https://www.youtube.com/watch?v=Rh18GMwwV4M

- Pour a little water into the bottom of the bottle. This will help stabilise the rain gauge and prevent the wind from knocking it over.
- Place the rain gauge in an outdoor area. As it rains, you will see the water level rise in the bottle, allowing you to measure the amount of rain.

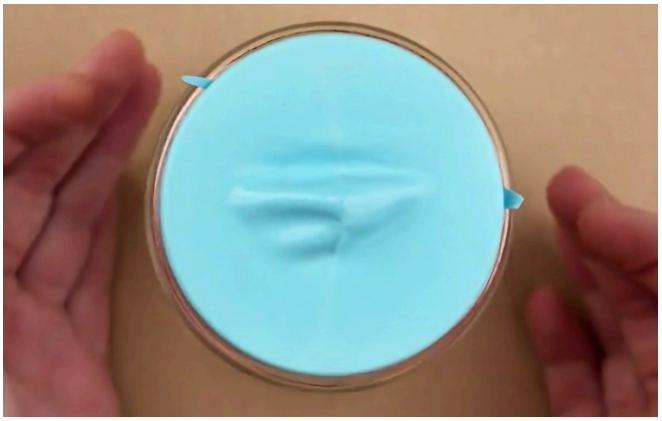
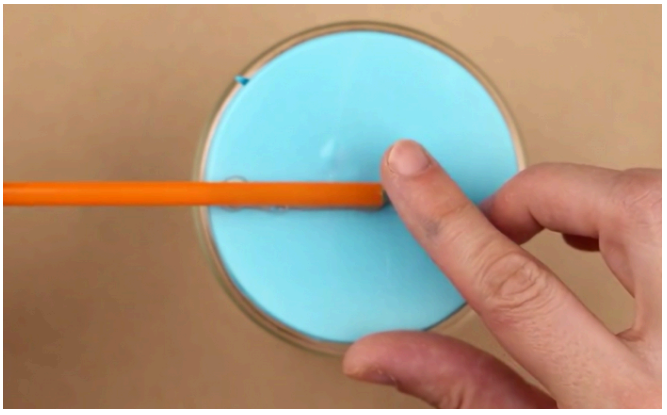
15 min.	Construction of the barometer according to the following steps: - Take a balloon and cut off the nozzle, as shown in the figure.  *Figure 1.2.7 Cut balloon nozzle. Source: WikiHow. Link: https://www.wikihow.com/Make-a-Simple-Weather-Barometer* - Stretch the wide part of the balloon and place it over the mouth of the bottle, so that it has a taut, elastic surface, as shown in the figure.  *Figure 1.2.8 Place the stretched balloon over the mouth of the bottle. Source: WikiHow. Link: https://www.wikihow.com/Make-a-Simple-Weather-Barometer* - In the center of the elastic surface of the balloon, glue one end of a straw using some liquid glue or silicone. If the straw has a bent end, cut it off before glueing. The straw must be kept for as long as possible. 

	Figure 1.2.9 Glue the straw over the balloon. Source: WikiHow. Link: https://www.wikihow.com/Make-a-Simple-Weather-Barometer - Lightly press the straw onto the balloon and wait for the glue to dry completely. - Tape a sheet of paper to a wall and place the bottle next to it, so that the straw is pointing towards the paper. Mark on the paper the starting position of the straw and write "high" above the mark and "low" below it, as shown in the picture. -  *Figure 1.2.10 Final result of the constructed barometer. Source: WikiHow. Link: https://www.wikihow.com/Make-a-Simple-Weather-Barometer* - As the air pressure changes, the straw will move, pointing higher as the pressure increases and lower as it decreases. You can add small marks on the paper to record changes in the position of the straw and observe how your barometer works.
15 min.	Construction of the anemometer according to the following steps: - Take one of the five plastic cups and use a hole punch to make four symmetrically distributed holes close to the top edge of the cup. - 

Figure 1.2.11 Drilling 4 holes in the cup. Source: Science Buddies. YouTube channel. Link: https://www.youtube.com/watch?v=Af0LB3abBsk

- Insert the straws through the holes in the cup. If the straws have bent ends, cut them off before inserting them. The straws should form a cross in the centre of the cup.

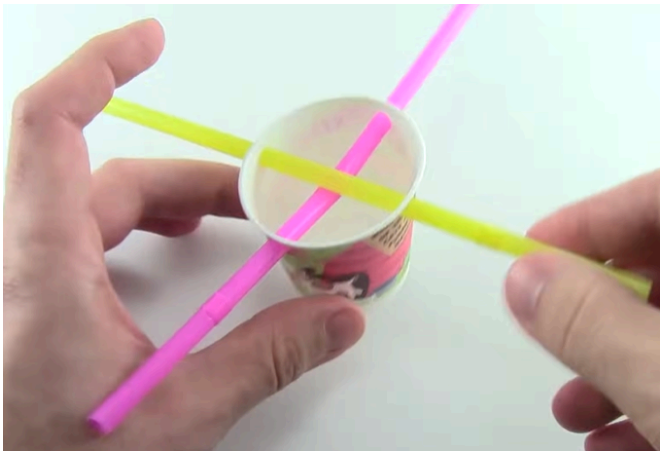


Figure 1.2.12 Insert the straws through the holes in the cup. Source: Science Buddies. YouTube channel. Link: https://www.youtube.com/watch?v=Af0LB3abBsk

- Take the remaining four plastic cups and make two holes in each at approximately 1.5 cm apart, as shown in the figure below.



Figure 1.2.13 Drill 2 holes next to each other in the remaining cups. Source: Science Buddies. YouTube channel. Link: https://www.youtube.com/watch?v=Af0LB3abBsk

- Insert one end of each straw into the holes of each of the remaining four cups. Make sure that the cups are attached to the ends of the straws so

that the system forms a structure like the one shown in the following figure.



Figure 1.2.14 Placement of cups and straws. Source: Science Buddies. YouTube channel. Link: https://www.youtube.com/watch?v=Af0LB3abBsk

- With the tip of the pencil, make a hole in the centre of the base of the central glass (the one with the cross-shaped straws).
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Figure 1.2.15 Drilling a hole in the base of the center cup. Source: Science Buddies. YouTube channel. Link: https://www.youtube.com/watch?v=Af0LB3abBsk

- Insert the pencil through the hole in the base of the centre cup, with the eraser inside the cup. Then, use a punch pin to fix the straws at the point where they intersect, sticking the punch pin into the eraser of the pencil.



Figure 1.2.16 Attach the pencil with the cup and straw system using the punch pin. Source: Science Buddies. YouTube channel. Link: https://www.youtube.com/watch?v=Af0LB3abBsk

- For the base, take a bottle and, with the help of a pair of scissors, make a small hole in the centre of the cap, big enough for the tip of the pencil to pass through. Fill the bottle with water to serve as a weight to stabilise the anemometer.
- Place the pencil (with the cup and straw system) in the hole of the bottle cap. Finally, test your anemometer by using a hair dryer or placing it in the open air. You will see it spin at a speed directly proportional to the wind speed.

15 min.

Construction of the weather vane follows the next steps:

- Take one of the paper plates and, on the bottom, write the four cardinal directions: North (N), South (S), East (E), and West (W), as shown in the figure. Also, mark the approximate centre of the plate. If you wish, you can add additional drawings or decorations.

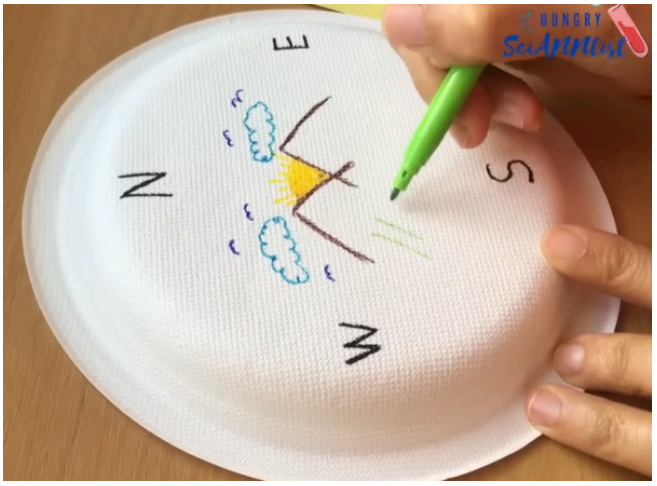


Figure 1.2.17 Write the four cardinal directions. Source: Hungry SciANNtist. YouTube channel. Link: https://www.youtube.com/watch?v=jHgHcuCRXmA

- Use a piece of cardboard and, with the help of a ruler, draw the front and back of an arrow according to the measurements shown in the figure.

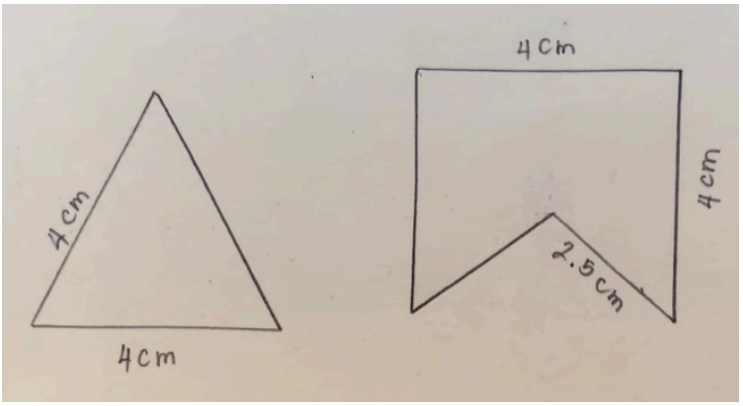


Figure 1.2.18 Draw the front and back of an arrow on a cardboard. Source: Hungry SciANNtist. YouTube channel. Link: https://www.youtube.com/watch?v=jHgHcuCRXmA

- Cut out both pieces.
- Measure the length of the straw and, using a ruler, mark the center of the straw. If the straw has a bent end, cut it off before continuing.
- Stick the straw in the centre using a punch pin. Then, glue the arrow pieces (the tip and tail) to the ends of the straw, making sure they are well aligned to create an arrow like the one shown in the next figure.

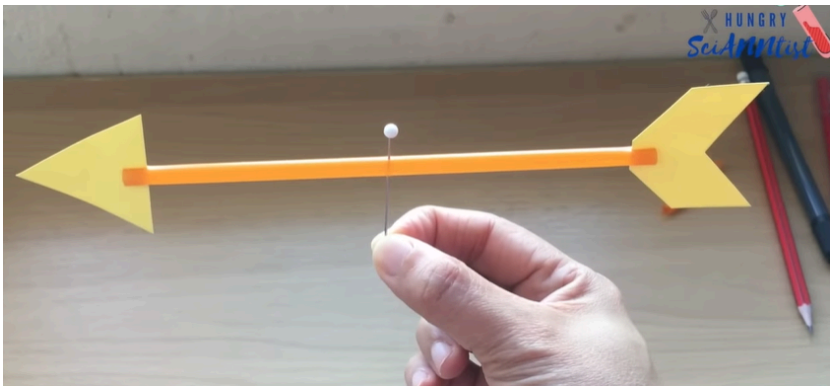


Figure 1.2.19 Arrow created. Source: Hungry SciANNtist. YouTube channel. Link: https://www.youtube.com/watch?v=jHgHcuCRXmA

- Insert the punch pin into the centre of the pencil eraser. Make sure that the arrow can rotate freely without the pencil moving, as the pin will act as an axis.
- Take the other paper plate and place a piece of clay inside.

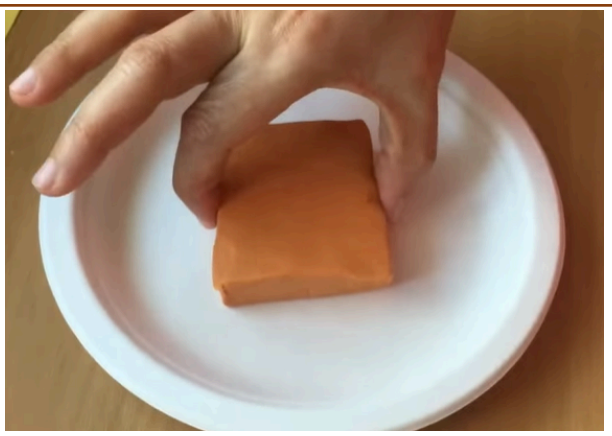


Figure 1.2.20 Place the clay inside the plate. Source: Hungry SciANNtist. YouTube channel. Link: https://www.youtube.com/watch?v=jHgHcuCRXmA

- Place the decorated plate (the one with the cardinal directions) on top of the plate with the clay, making sure that the centres are aligned. Use some glue to fix the two plates together and create a stable base.
- Insert the sharp end of the pencil into the center of the decorated plate, at the mark you previously made, to complete the construction of the weather vane.
- You can test the functionality of the system by using a hairdryer or by placing it outdoors, and you will see how the arrow will orient itself in the direction of the wind.

10 min.	Functional testing of each of the elements constructed.
20 min.	Presentation of the stations created by each group and a small debate on the main difficulties encountered in the assembly and development of the system.

Formative assessment

- Participation and collaboration in the groups will be evaluated.
- The construction of the weather stations will be evaluated, assessing their design, functionality, and originality.

Feedback

Net Promoter Score (NPS) is a widely used metric to gauge the loyalty and satisfaction of customers or, in an educational context, students. It measures the likelihood of the students recommending the lesson or course to others. Here is how you can describe and implement NPS:

Develop the NPS Question:

- Primary Question: "On a scale of 0 to 10, how likely are you to recommend this lesson to other students?"
- Follow-up Questions: "Why did you choose that score?" and "How can we improve this lesson?"

Collecting Responses:
A template for collecting feedback using paper surveys is shown in the Annexes.

- Digital Surveys: Use online tools like Google Forms, SurveyMonkey, or Typeform to distribute the NPS questions to students.
- Paper Surveys: Hand out paper questionnaires at the end of the lesson for students to fill out.
- Interactive Applications: Utilize interactive apps like Quizziz, Mentimeter, or Kahoot! to gather real-time responses.

Classifying Responses:

- Promoters (Score 9-10): Students who are highly satisfied and likely to recommend the lesson.
- Passives (Score 7-8): Students who are satisfied but not enthusiastic; could switch their opinion easily.
- Detractors (Score 0-6): Students who are dissatisfied and unlikely to recommend the lesson; may provide constructive criticism.

Calculating the NPS:

- Formula: NPS = % of Promoters - % of Detractors.
- Interpreting the Score: NPS ranges from -100 to +100. A positive score (above 0) is generally good, and a score above 50 is excellent.

Analysing and Using Feedback:

- Review additional comments to understand the reasons behind the scores.
- Identify patterns and specific areas for improvement from detractors and passives.
- Use positive feedback from promoters to reinforce successful aspects of the lesson.

Annexes

Examples of weather stations:

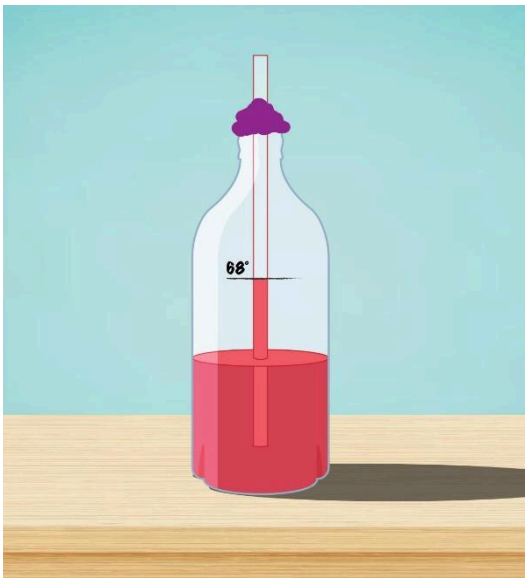


Figure 1.2.21 Example 1 of thermometer. Source: bluemarble. Link: https://thinkbluemarble.com/learning-galaxy/activity-lab/make-a-homemade-thermometer/



Figure 1.2.22 Example 2 of thermometer. Source: 123homeschool4me. Link: https://www.123homeschool4me.com/homemade-thermometer/

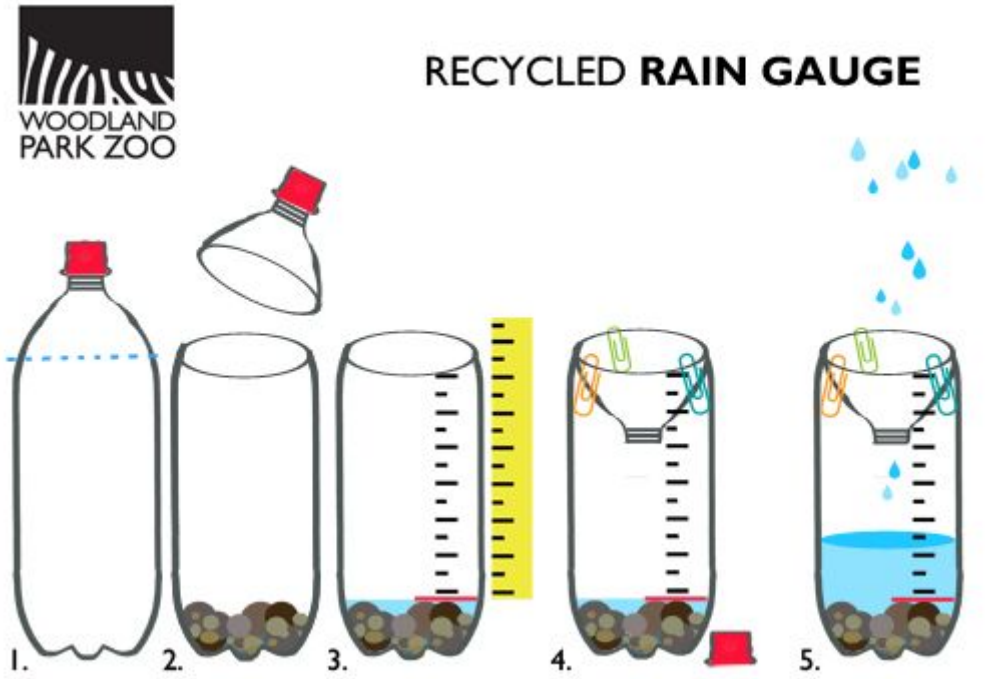


Figure 1.2.23 Example 1 of rain gauge. Source: Roundthorn Primary Academy Science. Link: https://roundthornscience.wordpress.com/2021/02/26/how-to-make-a-rain-gauge/



Figure 1.2.24 Example 2 of rain gauge. Source: Craft corner diy. Link: https://craftcornerdiy.com/kids-activities/how-to-make-a-diy-rain-gauge

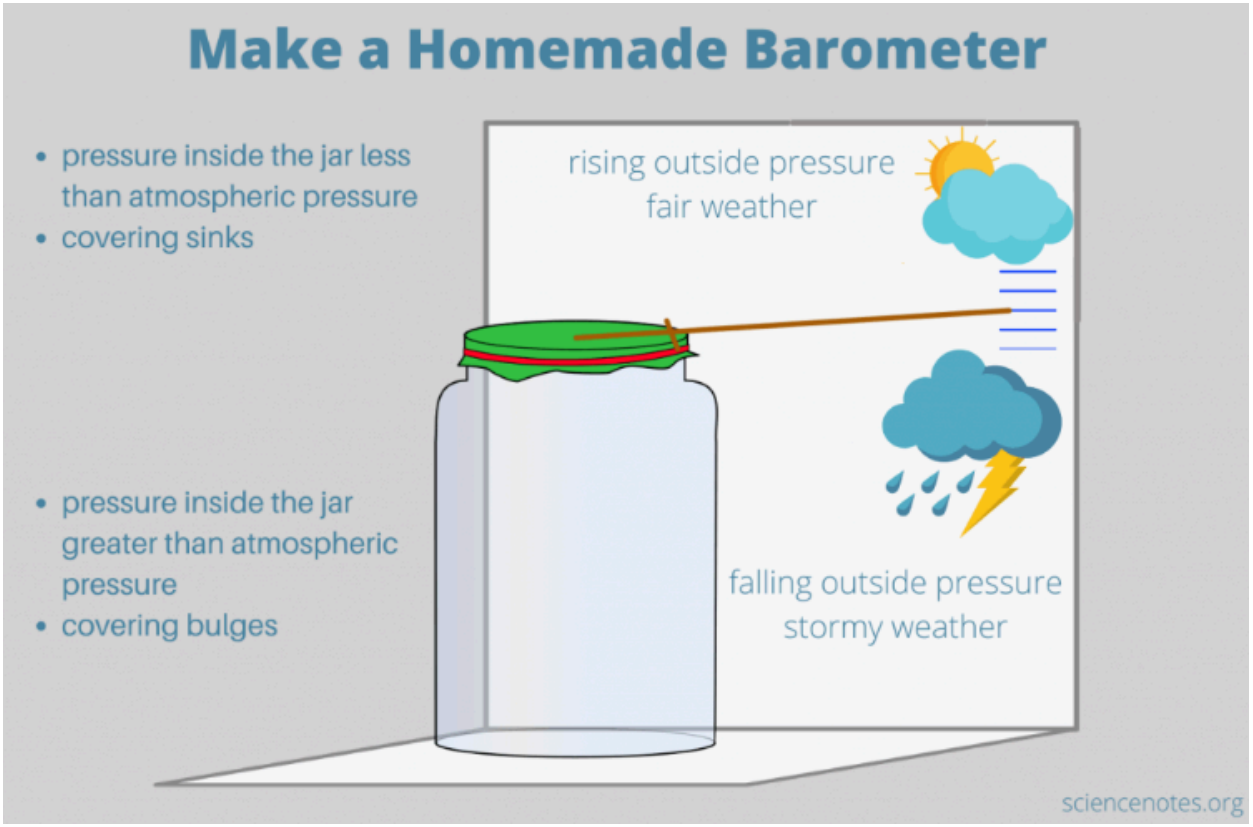


Figure 1.2.25 Example 1 of the barometer. Source: Science Notes. Link: https://sciencenotes.org/how-to-make-a-homemade-barometer-2-ways/

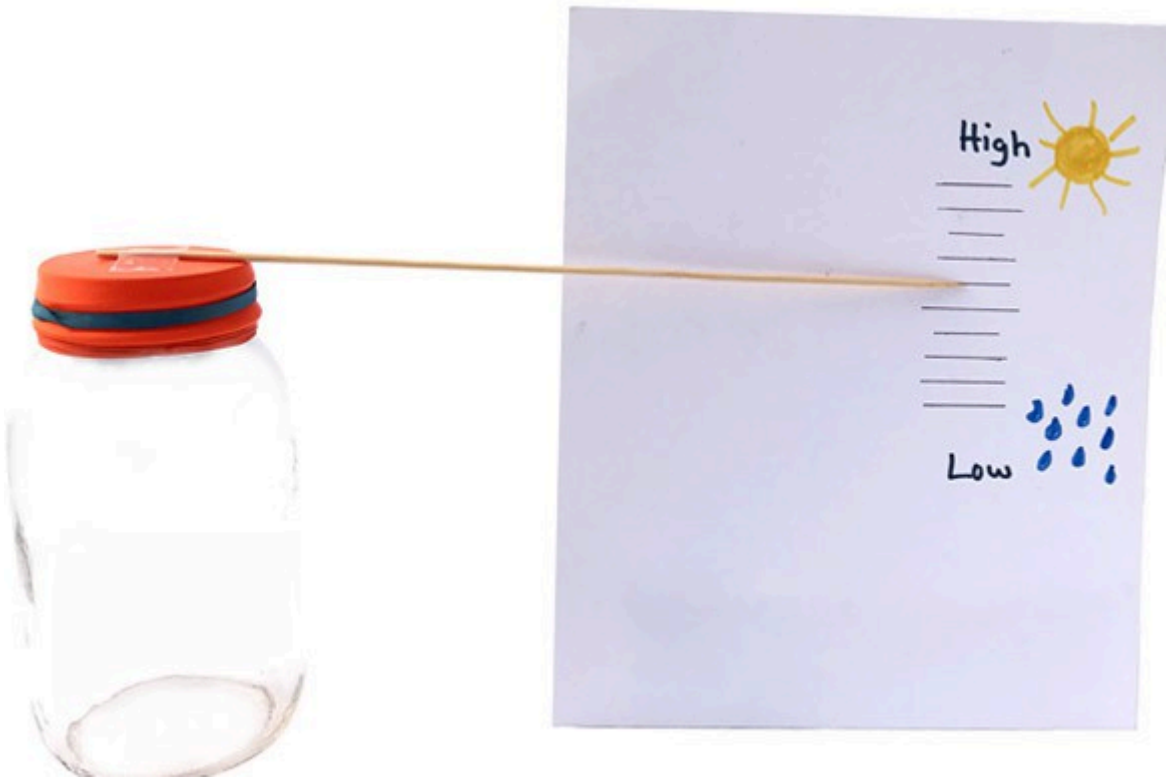


Figure 1.2.26 Example 2 of barometer. Source: Science Buddies. Link: https://www.sciencebuddies.org/stem-activities/balloon-barometer

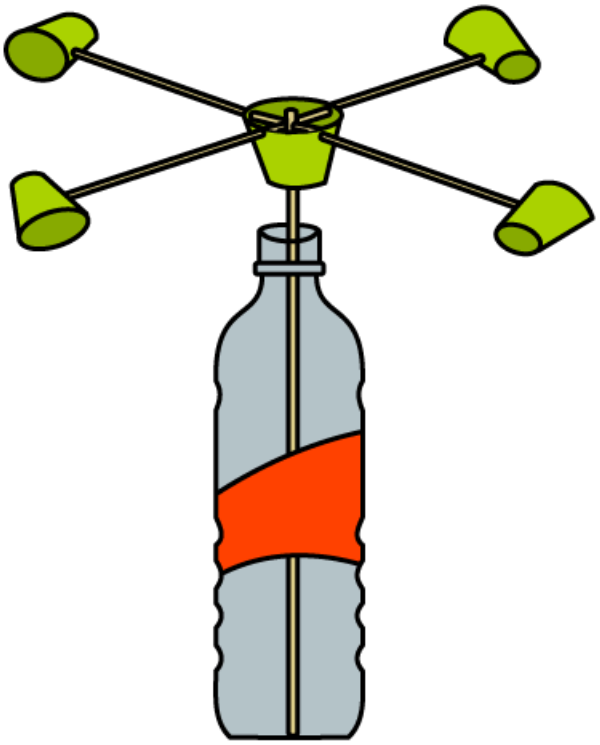


Figure 1.2.27 Example 1 of anemometer. Source: Education.com. Link: https://www.education.com/science-fair/article/make-anemometer/



Figure 1.2.28 Example 2 of the anemometer. Source: DIY Projects. YouTube channel. Link: https://www.youtube.com/watch?v=cWzGDEDVEgY

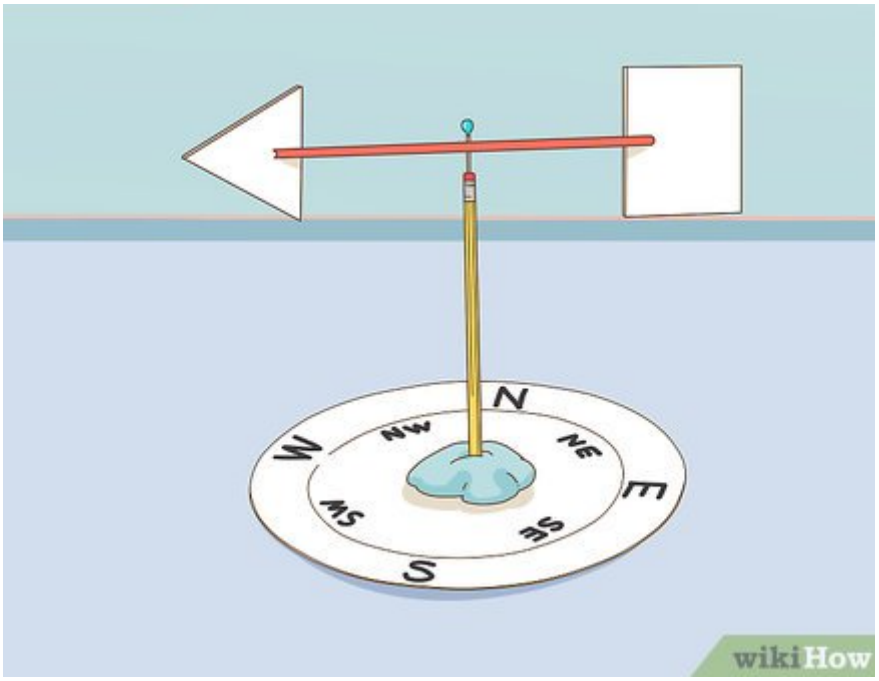


Figure 1.2.29 Example 1 of a weather vane. Source: WikiHow. Link: https://www.wikihow.com/Make-a-Wind-Vane

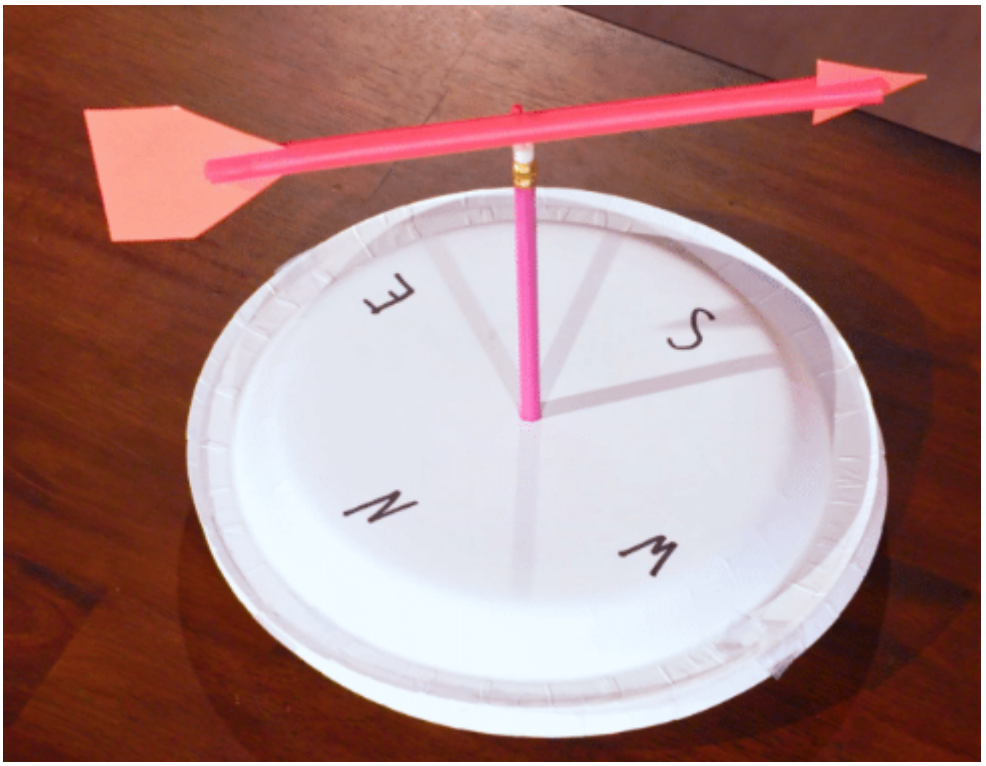


Figure 1.2.30 Example 2 of the weather vane. Source: Generation Genius. Link: https://www.generationgenius.com/activities/weather-vs-climate-activity-for-kids/

QUESTIONNAIRE TO COLLECT FEEDBACK ON THE LESSON

On a scale of 0 to 10, how likely are you to recommend this lesson to other students?

0	1	2	3	4	5	6	7	8	9	10

Not likely at all Extremely likely

Why did you choose that score?

How can we improve this lesson?