Educational Programme

EUR-OCEANS, European Network of Excellence; http://www.eur-oceans.info

Kit "Weather Station"

Track the weather and
be part of the network of EUR-OCEANS observers !

Contents

THE CLIMATE

Meteorologists are, among other things, recording our weather to be able to make forecasts, but why? Is it only for knowing, if there may be enough wind tomorrow to go windsurfing? Not really. Meteorology is much more than that!

It is the study of the atmosphere of our planet and the mechanisms and driving forces, responsible for our weather and climate.

Observations and especially, precise predictions are, for example, essential in our daily life; for aeroplane and ship navigation, for agriculture or to establish early-warning systems for potentially dangerous events like hurricanes or floods.

How to differentiate between weather and climate?

* **The weather:** is only a snapshot of the atmosphere at a particular place at a particular moment in time. It comprises the temperature, solar radiation, precipitation, etc. Thanks to long time records of the weather scientists have been able to determine tendencies and averages on longer time scales (centuries) – the climate. By comparing these records they could detect changes in the world's climate within the last decades

* **The climate:** corresponds to average conditions of temperature, precipitation, humidity, wind, etc. To obtain averages of such parameters the weather has to be observed and recorded for many years. This is done by numerous meteorological stations. Precise records of data also facilitate the development of computer models that allow us to simulate future scenarios of weather and climate, and thus, to make predictions.

Vegetation represents also a good indicator of the climate in a given region. The intensity of solar radiation is not the same at every place on our planet's surface. It is highest in the equatorial region and decreases towards the poles. This results in different climate zones that are like bands parallel to the equator.

Nevertheless, the distribution of different climates is not only related to the latitude: The Sinai desert (south of Israel), the Mount Everest and the forests of Florida lie all within the 28° northern latitude and show totally different climates. For example, altitude and the proximity to an ocean, has also a strong influence on the climate. We differentiate between the following types:

-> Tropical and subtropical
-> Polar (inland ice, tundra)
-> Humide et aride
-> Montane
-> Mediterranean
-> Continental (taiga)
-> Temperate

Take part in the observation network!

1) First, make all the instruments you need for your weather station. Enclosed you will find the guide to tinker each of them.

   Note: We have chosen the less expensive materials. As they might be fragile, we suggest to keep them in your classroom and only take them outside each time you want to take a measure. Of course, if you wish, you can also use other materials, but please respect the dimensions written in the guide in order to be able to compare your data with the ones from the other schools.

2) To record your measures, which **should be taken once a day** (preferably everyday, the same time) prepare a field book or print our model (annex).

3) Do not forget to enter your data on the website. Thus, you will be able to make graphs and comparisons with the measures made by other European schools! Connect once a week to the following link:

   http://www.eur-oceans.info/FR/education/projects/meteo/online.php

   To inscribe, write to us and obtain login and password.

Instruments for your weather station

Thermometer

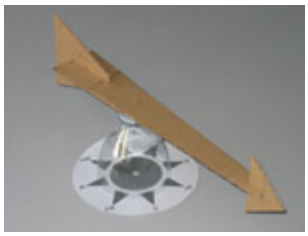
The Thermometer is an instrument used for measuring the temperature. You have for sure already seen different thermometers. Glass thermometers for example, are closed glass tubes containing liquids such as alcohol or mercury. When the temperature around the tube heats the liquid, this liquid expands and moves up the tube. From a scale you can read off the actual temperature - but there are many different thermometers. To record the temperature outside, a glass thermometer or a digital thermometer can be used. Because it is difficult to construct a thermometer which is precise enough, we would ask you to take one from home, if there is none available at school. The unit of measure should be in °C (degree centigrade) and it is sufficient to give values with one decimal place (for example: 18.5).

Hygrometer

The hygrometer is an instrument for measuring the humidity of the air. You have for sure already experienced dry air, or very high humidity for example in your bathroom, when you take a hot shower. The hygrometer measures the relative humidity. That means the content of water the air holds at a given temperature, in relation to the amount it could hold, when it was saturated. Therefore, when the hygrometer shows for example 70, it means that the air has 70% saturation. Because it is difficult to construct a hygrometer which is precise enough we would ask you, if possible, to take one from home (if there is none available at school). It will be sufficient to give the values without decimal place.

Because it is difficult to construct a **thermometer** and a **hygrometer** precise enough, we would ask you to use one from your school, or to take one from home, if possible.

Weather vane



Listening to the weather news we can hear for example, "there will be westerly winds". You see that the direction of the wind is always given with a point of the compass. "Westerly winds", or "north-westerly winds", but what does this tell us? Is that the direction where the wind comes from or is it the direction in which the wind blows? How can the wind direction be determined, anyway? Thanks to an instrument called a weather vane. This arrow is combined with a wind rose, which is oriented with a compass so that the north of the wind rose is actually really pointing towards the magnetic pole of the earth. So when the wind blows the vane moves, the arrowhead points in a certain direction and shows you where the wind is coming from! Thus, do we hear "westerly winds" in the news, the meteorologist tells us that there will be wind coming from the west.

Anemometer

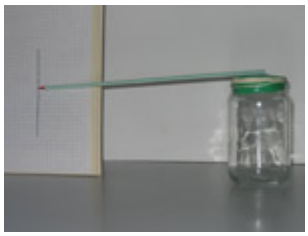
When there is wind we can measure two factors. The wind direction we can measure with a weather vane, as we have seen before. The other factor is the wind velocity. This can be measured with an anemometer. The anemometer is some sort of wind wheel, which rotates at a certain velocity according to the strength of the wind. The rotations of the anemometer can be counted and the wind velocity can be given in "revolutions -or rotations- per minute (rpm)". This is the value that you are supposed to record and type in the computer. Our value of the wind velocity is of course, only an approximation, because there are more forces acting on an anemometer that will be neglected here for simplicity!

After the instructions how to construct an anemometer:
Just to let you know how we transform rpm into m/s: As we know the circumference of the circle our cups make, we multiply this by the rpm you have measured. If the circumference is in 'meters', we get 'meters per minute' and from that it is easy to calculate meters per second, m/s.

Rain gauge

Although some of us might not like rain too much, it is still very important. For taking records of how much it rains, we need an appropriate instrument. The instrument that we will use for our weather station is called a "rain gauge". It is just as simple as a bottle,that is placed outside and collects the rain. It has a scaling from which we can determine the amount of collected water. Rain and snow is called "precipitation". The measure of the precipitation should be taken once a day, which allows for recording the amount of rain that has fallen within 24 hours.
The unit should be in millimetres (mm) and it is sufficient to give values without decimal place (for example: 1 mm)

Barometer



Maybe you already know that the pressure of the air gives us the information of how the weather will develop. High or low pressure means different weather situations. In simple words, high pressure means good and low pressure means bad weather. You will construct a simple barometer: the instrument will allow you to track changes in the air pressure.

You will be able to measure the differences in millimetres the pointer will move up or down along a scale. Try to relate high or low pressure to the weather situation. The unit should be in millimetres (mm) and it is sufficient to give values without decimal place.

References:
• Resources for Science Learning; the Franklin Institute (http://sln.fi.edu/weather/todo/todo.html)
• Fondation Polaire Internationale (http://www.educapoles.org)

Construction guide

If possible, borrow a **thermometer** and a **hygrometer** from your school or from home.

Anemometer

Material:

* 5 paper or plastic cups (11cl; making holes into paper cups is easier)
* straight straws
* 1 pencil with rubber end
* 1 small nail
* small stapler
* scissors
* 1 red marker

Instructions:

- Make 2 holes (cutting a cross for example is sufficient) at opposite sides into 4 of the five cups, just big enough that a straw can pass

- In the same way, make 4 holes into the 5th cup (centre cup) whereby, two opposite holes should be a bit lower so that the straws do not interfere with each other when they cross

- Make a hole into the bottom of the centre cup that is wide enough that the pencil can pass easily

- Adjust the straws to a length that the centres of the opposite cups are 20cm apart from each other (either by cutting if they are too long - or if they are too short you can put two together by putting one into the other with an overlap of ca. 2cm and cut the ends so that the overlap is in the middle)

- Put the straw through the holes of one of the cups, bend the tip of the straw and staple it to the wall of the cup

- Put the other end of this straw through two opposite holes of the centre cup and fix the next cup like the one before *Note: the cup has to have the opening towards the opposite direction of the first one!*

- Do the same with the other straw and the 2 remaining cups

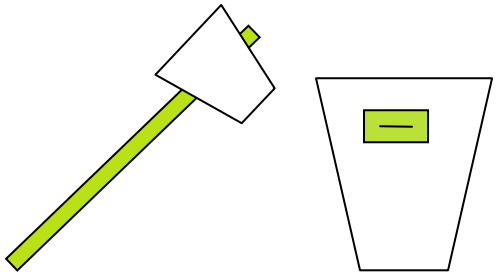
- All the openings of the 4 cups should be either oriented clockwise or counter clockwise.

- At last, put the pencil with the rubber end up, through the bottom hole of the centre cup and fix the straws, where they cross, with a nail to the rubber of the pencil; push the nail as far as you can into the rubber

- Label one of the cups with the red marker to be able to count the number of turns more easily.

Note: make sure that the anemometer turns easily!

Anemometer

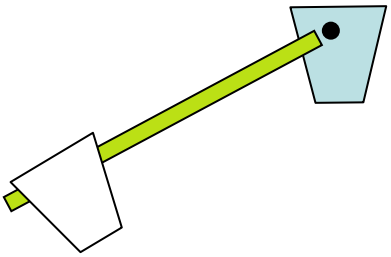


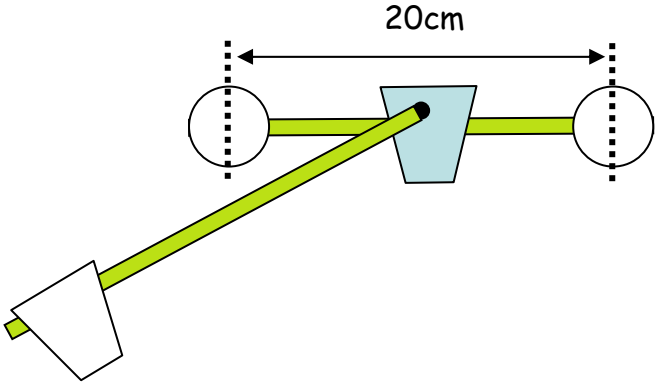
1

Make two holes into the cup on opposite sides, put the straw through it, bend the tip so that you can fix it with a small stapler

2

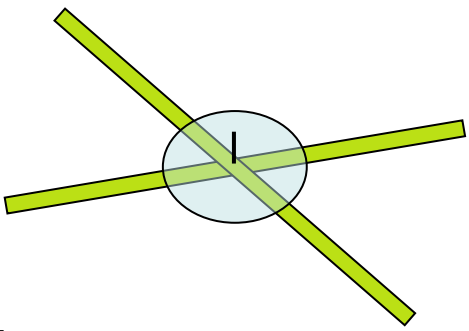
Put the straw through the centre cup and fix the next cup like the one before
Note: this cup should point into the other direction





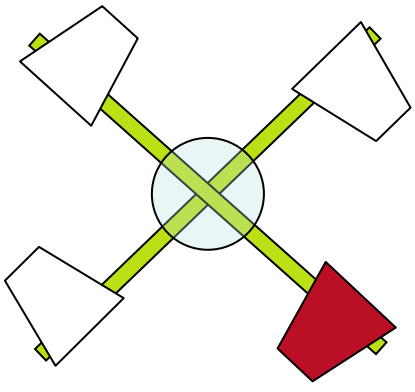
3

Do the same with the second straw; all the openings of the cups should be oriented either clockwise or counter clockwise



4

Put the pencil through the bottom hole of the centre cup and fix the straws with a nail into the rubber end of the pencil;
Make sure that the anemometer can rotate easily



5

Label one of the cups so that you can easily count the number of revolutions

Rain gauge

Material:

* 1 plastic bottle (1.5l mineral water bottle if possible without any structures)
* 1 cutter or scissors
* 1 coat hook made of wire or any strong wire
* 2 rubber bands
* 1 ruler (20cm)
* 1 stick (e.g. broom stick) or board
* 1 water-resistant pen
* maybe a small nail and a hammer

Instructions:

- Cut the upper, bended end off the empty plastic bottle

- The bottom of the plastic bottles are rarely flat thus, direct measuring of the water level after a rain would bias the result. Put therefore, a bit of water into the bottle until the straight part. Mark the level of the water with the water-resistant pen. When the rain gauge is set outdoors the bottle should be filled up with water up to this mark

- Fix the ruler outside the bottle with the rubber bands as follows:
    a) turn the ruler with the scale outwards
    b) adjust the ruler so that the number 0 is exactly at the mark you did with the pen
    c) take care that the ruler is perpendicular to the bottom of the bottle

- Use the coat hook (or the wire) to form a support to be able to fix the bottle to the stick, take care that:
    a) the bottle can not slip through it
    b) the bottle can be easily removed upwards
    c) that the folded coat hook or wire does not slip down along the stick

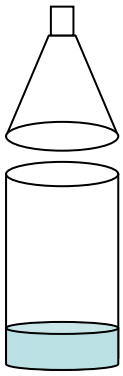
  depending on what you have chosen (stick or board) it might be necessary to fix the support with a nail

- Take the upper end of the bottle that you removed, and put it upside down onto the bottle like a funnel

- Finally, put your rain gauge outside at a place, where it is not covered by a roof or a tree (stick it into the ground or with a stand on the floor) and take care that it is standing in a vertical position

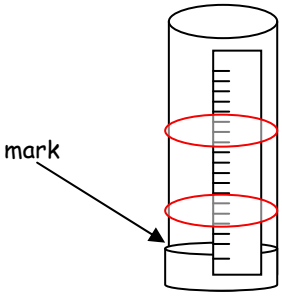
- Once the rain gauge is installed, before starting the period of measurement (24 hours) make sure that the bottle is filled up with water until the mark you did (level 0)

Rain gauge



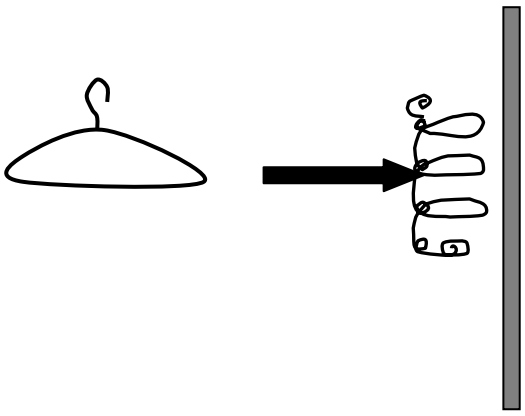
1

Cut the top off the bottle and (if the bottle is arched) fill it up with a bit of water just until its straight part mark the water level with a water-resistant pen



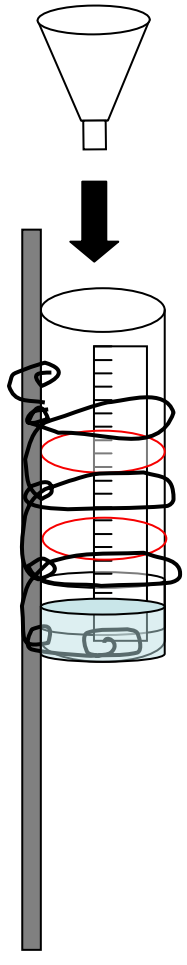
2

Fix the ruler to the outside of the bottle with the rubber bands, so that the 0 of the ruler is congruent with the mark you did



3

Bend the wire in a way around the stick that allows you to have a support where the bottle is stable but can be removed easily, anytime



4

Put in the bottle, put the upper end on top like a funnel and mount your rain gauge outdoors

Weather vane

Material:

* ruler
* scissors
* glue
* 1 compass
* 3 plastic pearls with a hole or small washers
* 1 stick (e.g. broom stick)
* balsa or strong carton
* 1 small nail and a hammer (the diameter of the nail should be slightly smaller than the one of the holes in the pearls)

Instructions:

a) For the weather vane:

- Draw the forms that are illustrated in the scheme onto the balsa/carton and cut them out

- Assemble the parts and use glue for fixation, let it dry

- Search on the arrow that you constructed, the equilibrium point, where it can rest balanced on a tip of your finger without pitching to any direction, mark the point and make a hole with the nail

b) For the wind rose:
Either print out the model included in this file, glue it onto a carton and cut it out, or make it on your own:

- Onto a piece of carton draw two concentric circles with the help of the pair of compasses, whereby the diameter of the inner circle should be a bit smaller than the diameter of the stick on which you will mount your weather vane

- Divide the circle into 8 similar parts

- Mark the points of the compass like you can see in the model

- Cut out the wind rose and the inner circle

- Put the wind rose onto the stick

c) General assembly:

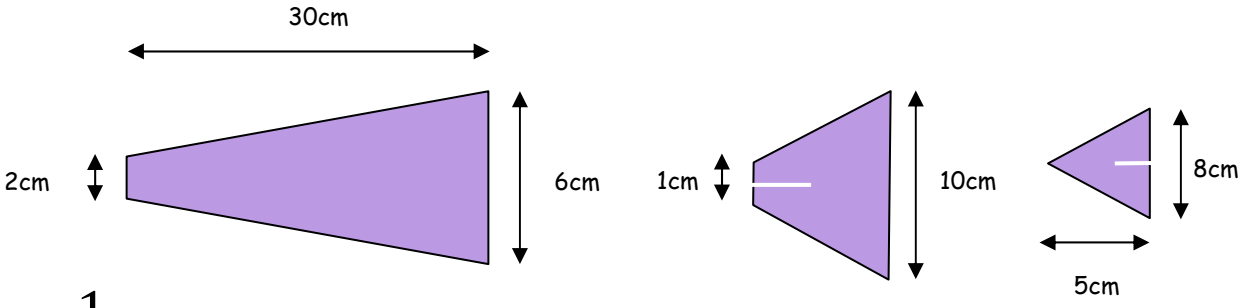
- Take the stick with the wind rose, and fix the weather vane with a hammer and a nail on top of the stick; you can put some pearls or washers underneath

- It is essential that the weather vane turns very easily!

- When you determine the wind direction, the wind rose has to be oriented with a compass!

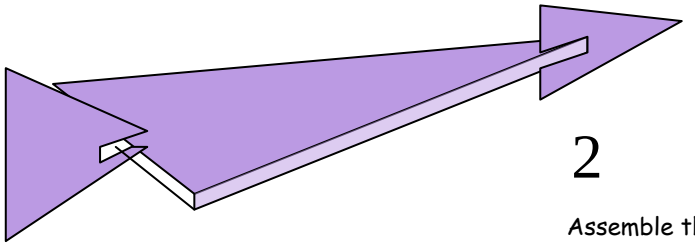
When it is well constructed the weather vane points in the direction from where the wind comes

Weather vane



1

Draw the indicated forms wit the displayed measures onto the balsa/carton and cut them out

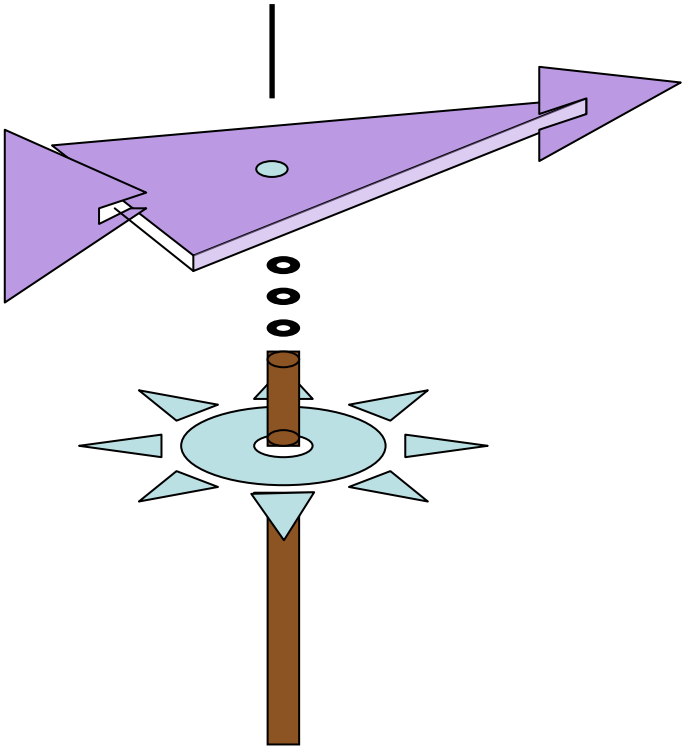


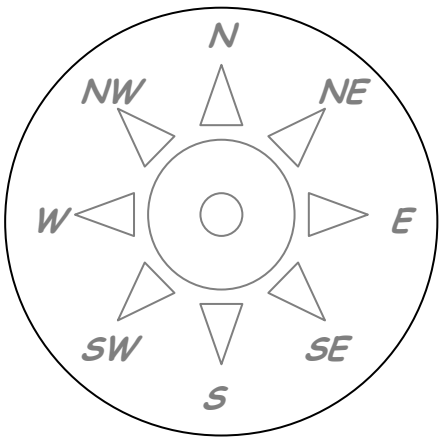
2

Assemble the parts and glue them, let it dry

3

Search the equilibrium point, mark it and make a hole; draw a wind rose on the carton, cut it out and mount it on the stick; fix the weather vane with a nail and a hammer to the stick, you can put some of the pearls or washers underneath; when you measure the wind direction you have to orient your wind rose with a compass!





Barometer

* 1 glass (empty glass for jam or pickles)
* 1 balloon
* straight straw
* 1 rubber band
* glue
* ruler
* scissors
* carton
* paper

Instructions:

- Take the balloon, cut the mouth piece and put it over the opening of the glass without any wrinkles and fix it with a rubber band

- Cut the straw with the scissors to a length of 20cm and cut it at one end to get the tip of a pointer (if the straw is too short you can put two together, like for the anemometer)

- Cut a piece of paper and draw a millimetre scale with the help of the ruler (you can of course also use the ruler itself)

- Glue the paper onto a carton

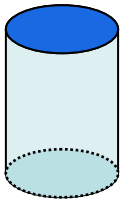
- Fix the blunt end of the straw with a drop of glue in the centre of the balloon

- Place the scale with a support in a way that the pointer is perpendicular to the scale

Function: When the air pressure is high, the balloon is slightly forced down and the pointer goes up; when the air pressure is low the balloon arches upwards and thus, the pointer goes down.

***Note:* The movement of the balloon will also be influenced by the temperature! The values that you will measure will thus, only be a rough estimation! It will therefore, be necessary to observe the barometer in relation to the change of the weather!**

Barometer

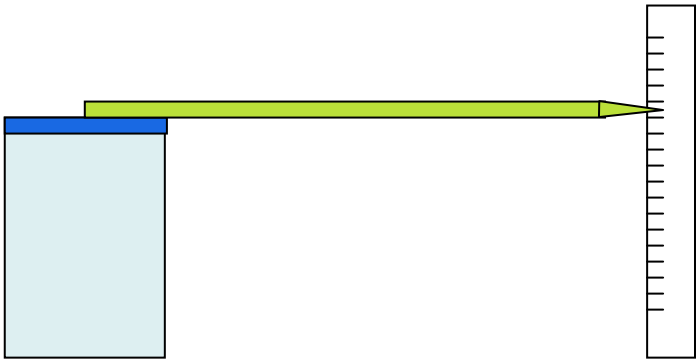


1

Cut off the mouth piece of the balloon to be able to cover the opening of the glass with the balloon so that no wrinkles can be seen and fix the balloon with a rubber band

2

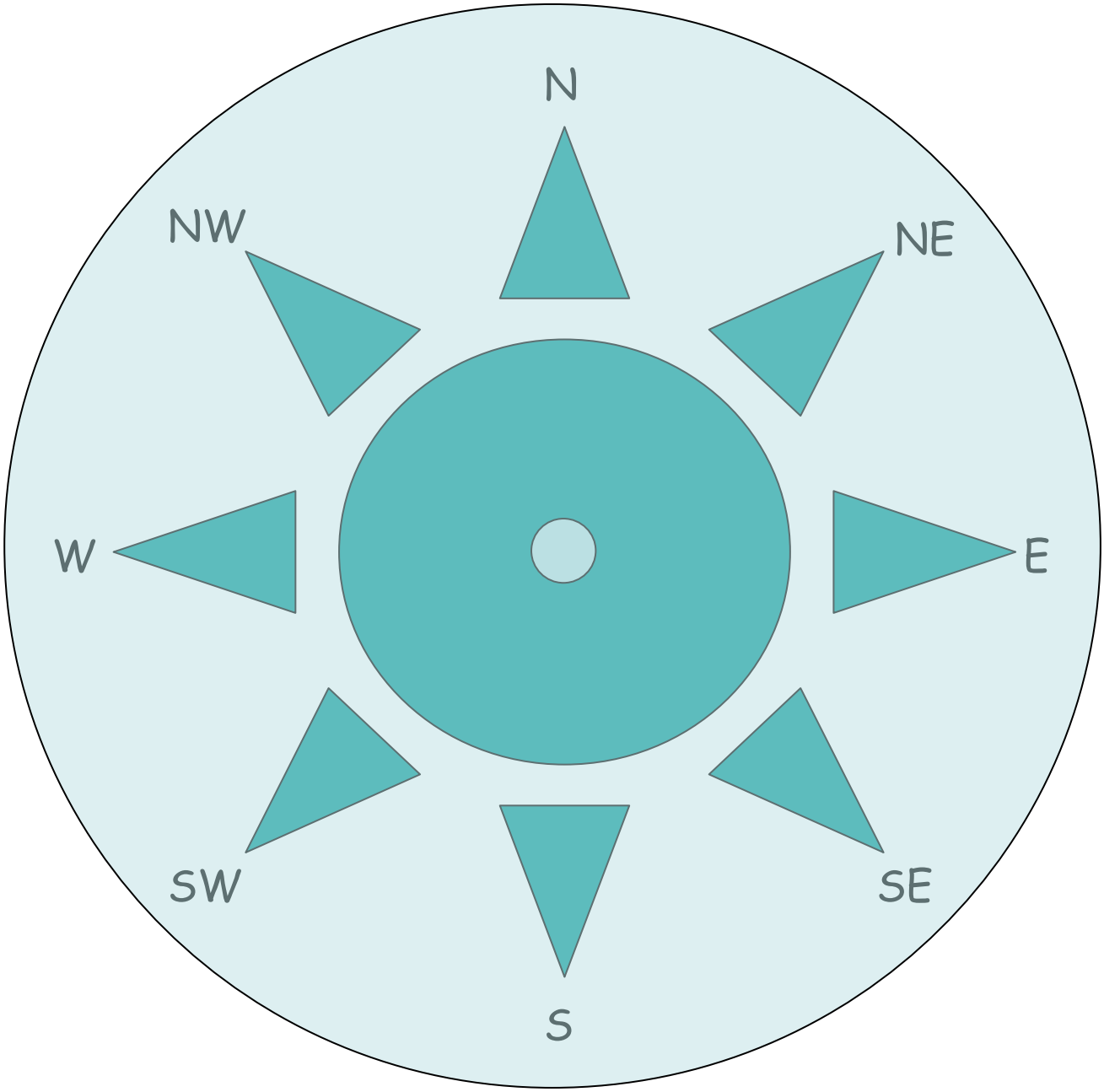
Cut the straw at one end so that you have the tip of a pointer



3

Fix the straw with the blunt end in the middle of the balloon using a drop of glue

Windrose



Date	Air temp (°C)	Wind velocity (rpm)	Wind direction	Precipitation (mm)	Air pressure (mm)	Relative Humidity (%)