Cloud Observation, Description and Identification

GLOBE		***Related SDGs:***	***Type of activity***
Sphere	**Protocols**		
Atmosphere	Cloud Classification and Contrails.	13 (Climate Action)	Application

Overview

The students observe and draw the clouds, describing their shape and using their own words. Initially, qualitative descriptions will be made and, later, a more scientific vocabulary will be used to deepen the analysis made. A relationship will be established among the students' descriptions and the standard classification of the ten types of clouds identified by GLOBE. Each student will have a personal cloud notebook to use along with the GLOBE Cloud Chart. Observation will be done over a period of days. At the end of this time, students make predictions about the weather and check them, using their observations.

Prerequisites
None.

Time: 10-minute observations (3 times a day) over the course of a week are discussed in a 40-minute class.

School level
Third year of Primary school onwards.

Purpose

To observe clouds, to describe them with everyday vocabulary and to compare this description with the official cloud names, stimulating students' interest to make observations about the type of clouds frequent in their area.

Student outcomes

- To identify the types of clouds in the students' locality using the standard cloud classification names.
- To study the relationship among cloud type, cloud cover and weather.
- To analyze the observed cloud types to make and attempt predictions.

Introduction

Accurate weather forecasting begins with careful and systematic observations. The human eye represents one of the best (and the most inexpensive) meteorological instruments. Much of what we know about weather is the result of human observation over thousands of years. While being able to identify clouds is useful in itself, observing clouds regularly and recording the weather associated with certain clouds will show students the relationship between cloud types and weather. Recognizing cloud types can help in forecasting the type of weather to expect in the near future. These relationships are not described here, but there are many meteorology books that can help students learn about them. Inviting a local meteorologist into a classroom to talk to students is a sure way to stimulate their interest in the relationship between clouds and weather patterns.

This activity asks the students to look carefully at the clouds, draw them and describe them in their own words before using the official names. The activity can be repeated on different days, when there are different clouds. In fact, if possible, it would be good to take a break and do "cloud work" outdoors whenever a new type of cloud appears in the sky. Over time, students will gain considerable familiarity with cloud types. If it is not possible to go outdoors whenever an interesting cloud appears, perhaps they can be observed through a window.

Creation of a Personal Cloud Notebook.

A set of individual, personal notes about clouds and cloud types can be included in the GLOBE science notebooks or in separate booklets. A page in the GLOBE science notebooks should be devoted to each cloud type that is identified. This can include not only the students' own observations and descriptions, but also photographs of clouds that they take or obtain from other sources. If several cloud types are seen, each should be noted on a separate page in their notebooks and, if possible, each cloud type should be photographed to associate with the classification.

As a supplementary practice, the use of the GLOBE Observer application could be incorporated to the observations and registration, to acquire skills in the identification and data entry into the application. This has the possibility of identifying clouds manually or using an assistant for the guided identification of clouds, which is based on a dichotomous classification system that guides the observer to choose between two options until the most accurate classification is reached.

Guiding Research Questions

- Are all clouds the same?
- Are they at the same altitude?
- Do some clouds allow us to see the sun behind them and some don't? Why?
- Do all clouds produce precipitation?
- Can I predict what the weather will be like in the afternoon or tomorrow from the clouds I see now?

Scientific Concepts

- The weather can be described by qualitative observations.
- The weather changes from day to day and throughout the seasons.
- Clouds are formed by the condensation of water vapor in the atmosphere.
- Clouds affect the weather and climate.
- The nature and extent of cloud cover affects the characteristics of the physical geographic system.

Materials and Tools

- GLOBE Cloud Chart
- Photocopies of the clouds described in this activity.
- GLOBE Science Notebook / GLOBE Observer App
- Bibliography containing images of clouds
- Cell phone / Camera or video camera to take pictures of the clouds (optional)

What to Do and How to Do It

Activity 1: Identifying and classifying clouds on a daily basis

Beginning -

To begin the activity, students go outside with the teacher and spend 10-15 minutes observing the sky and describing it. Can they see clouds? What do they look like? What shape are they, what do they resemble? What colors are they? Can they see the sky and the sun through them? Are there any other elements in the atmosphere that prevent them from seeing the sky and the clouds? If so, can they identify what it is?
Then they describe the clouds in their own words, whether they appear to be high or low in the atmosphere and what approximate percentage of the sky they cover, if they can estimate it (remember the practice of the four cardinal points).
Using their field notebooks, they are invited to draw the clouds they observe, as realistically as possible.

Development –

In class the GLOBE Cloud Protocol is reviewed, in which ten common cloud types are recognized. The names used for clouds are based on three factors: their shape, the altitude at which they are found, and whether they produce precipitation.

The GLOBE Observer application also takes into account whether clouds are transparent, translucent or opaque, considering the light passing through them and whether it is possible to see the sky or the sun behind the cloud.

Clouds have three basic shapes:

Cumulus (lumpy and swollen)
Stratus (in layers)
Cirrus (faint)

Clouds occur in three altitude ranges (cloud base altitude):

High-level clouds (above 6000 m), called "cirrus or cirro-".
- Cirrus
- Cirrocumulus
- Cirrostratus

Mid-level clouds (2000 - 6000 m), named by "alto-".
- Altocumulus
- Altostratus

Low-level clouds (below 2000 m), without a prefix
- Stratus
- Nimbostratus
- Cumulus
- Stratocumulus
- Cumulonimbus

Note: Although both cumulus and cumulonimbus clouds may have bases starting below 2000 m, they often become large enough to reach into the mid to upper range. For this reason, they are generally referred to as "vertically developing clouds". Only high-level clouds are wispy, so the term cirrus has become synonymous with wispy, as well as high-level clouds.

- Clouds, whose names incorporate the word "nimbus" or the prefix "nimbus-" are clouds that produce precipitation.

- Contrails are linear clouds that form around small particles emitted by aircraft. They are directly caused by human activity, and are of great interest to researchers. Three subtypes are distinguished:
  - Short-Lived Contrails: Line that appears behind an aircraft; it does not remain after the aircraft has passed.
  - Persistent Non-Spreading Contrails: Noticeable contrails (linear and narrow) that do not appear to dissipate appreciably or show signs of spreading, and which remain well after the aircraft that created them disappears from the area. Each contrail subtends a narrow angle in the sky.
  - Persistent Spreading Contrails: Linear cirrus clouds with a diffuse appearance; each trail subtends a wider angle in the sky.

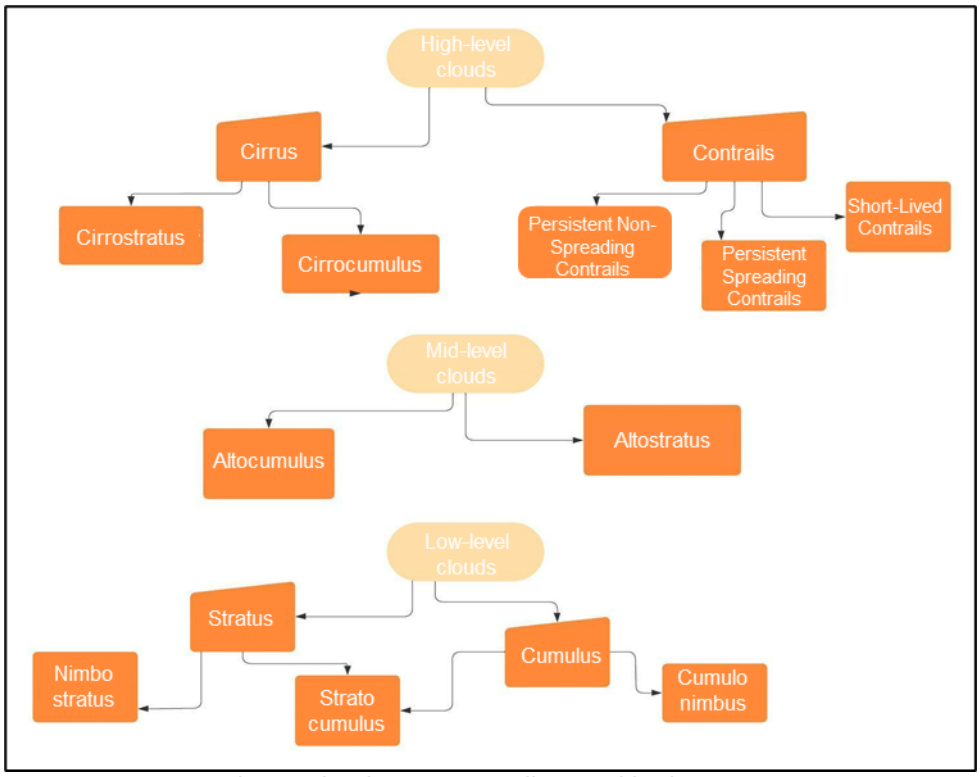

Fig. 1: Cloud types according to altitude range

Tips for Identifying Clouds

It is useful to know a few things to identify or name clouds according to official classifications: Clouds that are wispy and high in the sky are always cirrus clouds of one type or another. If cirrus clouds contain billows or puffs, then they are cirrocumulus. If they form continuous layers that seem to cover the sky, they are cirrostratus. Contrails also occur at high levels, and look like linear shaped clouds.

Clouds at medium altitudes are named with the prefix "alto-." If they are layered, they are altostratus; if they form piles or look puffy, they are altocumulus.

Clouds that form at low altitudes (below 2000 m) are of the cumulus or stratus family. Cumulus clouds are puffy and swollen. Clouds of the stratus family form layers or sheets that cover large areas of the sky.

Low-Level Clouds that are dark, threatening and rain-producing are called "nimbus". Nimbostratus clouds cover the entire sky with broad layers and produce continuous rain. Nimbostratus are more extensive horizontally than vertically. The precipitation associated with them is generally low to moderate in intensity, but falls over a wide area over a long period of time.

Cumulonimbus clouds have dark bases and swollen tops, often anvil-shaped, and are sometimes called "thunderheads". They usually produce heavy precipitation, usually accompanied by lightning and thunder.

Ask them to look for pictures of clouds in books, magazines, on the internet or their own pictures they have taken of landscapes. Additionally, you can ask them to take their own pictures of clouds, this will amuse them. Introduce this as a follow-up activity to drawing the clouds and describing them in their own words. Videotaping clouds in motion also introduces a new perspective on cloud formation and behavior, particularly if a tripod can be used and time-lapse photographs can be taken.

Closing -

Class display of the clouds observed through enlarged prints of the photos. Have the other students try to classify each other's clouds as they display them and guide them in identifying them.

They can even make three columns on the board and arrange the pictures according to the altitude range of the clouds to get used to classify them not only by their shape, but also by the height at which they develop in the atmosphere.

Activity 2: Observe the clouds several times a day to try to predict the weather.

Beginning –

- Over a period of five days, students are instructed to look closely at the clouds and record what they see in their science notebooks. If they do not yet know the names of the clouds, they can try to match them to those in the images above or the cloud chart, or they can write down what the clouds are shaped like.
- It would be best to observe the sky three times a day: once in the morning, once at local solar noon, and once in the late afternoon when it is still clear. The exact times of each observation are not critical, although it would help if the observations were made at the same time each day. For example, at 8 a.m., 1 p.m., and 5 p.m. If the student can make only one observation per day, it is best to choose a time within the local solar noon interval.

Development –

- Students should record the weather conditions at the time of each observation. Was it a rainy morning and a clear afternoon? Did it snow all day? Was it humid? The students do not have to quantify their weather information (they do not have to write down "21 mm of precipitation" or "79% relative humidity"), but they should describe the weather as thoroughly and clearly as possible. It is helpful to use a table like the one below to record day-by-day observations.

Table 1: Record of weather conditions

Day	It rained		Clouds (%)		Cloud type		Fog	
	Morning	Afternoon	Morning	Afternoon	Morning	Afternoon	Morning	Afternoon
Monday 14								
Tuesday 15								
Wednes. 16								
Thursday 17								
Friday 18								

- As cloud and weather observations are noted, look for any patterns. For example, are morning altocumulus clouds followed by afternoon thunderstorms? Are morning or

midday small puffy clouds ever associated with precipitation later in the day? Do they follow morning contrails, wide cirrus clouds, or altocumulus later in the day?

- Students can also develop their skills in observing the color of the sky (with their backs to the sun and matching the chart held up against the sky). They will be able to classify color into deep blue, blue, light blue, pale blue and milky blue. In addition, they can look at the visibility of the sky by taking a reference point on the horizon and working out whether it is hazy or not, and how clear the object looks in the distance; they can decide whether it is Unusually Clear, Clear, Somewhat Hazy, Very Hazy or Extremely Hazy.

Closing –

- After a week of recording clouds and weather, ask students to use their observations to predict the weather. Can they predict in the morning what the weather will be in the afternoon? Can they predict the weather the next day?
- Ask them to explain why they made the predictions they did. Each student will write down how they did in predicting the weather to develop and improve their skills. As a group, they will draw conclusions from what they observed.
- Posters can be made with the photos and drawings to display in the classroom or in the school corridors.

Frequently Asked Questions

What happens if the clouds and weather conditions are sustained for five days in a row?

This may occur in some places at certain times of the year. If you need to move on to other topics, you can have students comment on their observations without making predictions at that moment.
In weather forecasting, predicting that tomorrow will be the same weather as today is known as a persistence forecast, and it is usually correct more than half of the times. For a forecasting system to be useful, the forecast must be more accurate than a persistence forecast over a period of months and years.
Another approach would be to increase the observations made to more than five days, until more variety of cloud types and weather conditions are observed. Sometimes weather patterns stay in one place for a month or more, so you might have more success if you resume making measurements at a later date.

Suggested Resources

Different Types of Clouds

High-Level Clouds

Cirrus
These clouds look like delicate white feathers.
They usually have wispy shapes.
They contain ice crystals.

Cirrocumulus
These clouds are thin white layers with a texture that makes them look like a cotton field or waves without shadows. They contain mostly ice crystals and perhaps some very cold water droplets.

Cirrostratus
These clouds are a thin, almost transparent, whitish layer made up of ice crystals. They can cover all or part of the sky and create a halo appearance around the sun.

Short-Lived Contrails
Notice the short line of clouds above the streetlight. The plane is barely visible in this picture, but it is in front of the contrail.

Persistent Non-Spreading Contrails
These are different, with the ones on the right being persistent non-spreading, and the ones on the left being persistent spreading. Possibly all three types of aircrafts followed a similar path, but the high winds in the atmosphere blow from the right to the left and shift the older contrails to the left. The wake spreading on the left indicates that there is a fair amount of water vapor in the upper atmosphere.

Persistent Spreading Contrails.
Trails are shown in an area of heavy air traffic. As above, it is likely that the planes are following a similar path, but the trails are being spread by the wind. All of the contrails appear as wide or wider than those above, indicating the presence of abundant water vapor in the atmosphere. The cloud towards the center of the photo looks like the usual cirrus type, but from its position it would be likely that this cloud originated from a contrail.

Mid-Level Clouds

Altostratus
These clouds form a bluish or greyish veil that covers all or part of the sky. Sunlight can be seen through them, but there is no halo effect.

Altocumulus
These clouds look like white and gray sea waves and shadows. They contain mainly water droplets and maybe some ice crystals.

Low-Level Clouds

Stratus
These clouds are gray and are found very close to the Earth's surface. They usually look like a sheet but are sometimes found in patches. They rarely produce precipitation.

Stratocumulus
These clouds are gray or whitish in color. The bases of these clouds are usually round rather than flat. They may form from old stratus clouds or from spreading cumulus clouds. Their tops tend to be flat.

Nimbostratus
This is a dark or gray cloud layer that hides the sunlight. It is massive and produces continuous precipitation.

Cumulus
These clouds have a flat, dense base and a mound-shaped top reminiscent of a large cauliflower. When the sun shines on these clouds they are bright white. The base tends to be dark gray. They generally do not produce precipitation.

Cumulonimbus
They are large, heavy, dense clouds. They usually have a flat, dark surface, with very high and large tops resembling a large mountain or anvil. They often have associated lightning, thunder and sometimes hail. They can also produce tornadoes.

Bibliography

León, Francisco Martín, Quirantes, José Antonio. n.d. Observation and identification of clouds. *http://documents.meteo6g3r.es/meteodocs/unidad_nubes.pdf*

https://observer.globe.gov/