Natural events and GLOBE protocol bundles

GLOBE		***Related SDGs:***	***Type of activity***
Sphere	**Protocols**		
Atmosphere	All	3 (Health and Well-being 4 (Quality Education) 11 (Sustainable Cities and Communities) 13 (Climate Action) 15 (Life of terrestrial ecosystems)	Exploratory
Bundles	All existing GLOBE learning activities already in place for various topics (e.g., Agriculture, Weather, Soils, etc.).		

Overview

Students will identify natural events that occur occasionally and often affect the environment where they occur, their negative and/or positive impacts and which ones occur in their community. They will select GLOBE protocols to study according to their characteristics using the idea of "bundles".

Prerequisites
None

Time*:*
1 class

School level
Third year of Secondary school onwards (15 years and older).

Purpose

Students will learn about natural events and the threat they can pose to the place where they occur. They will understand the difference between natural events and those caused by human action. They will be able to link them to a set of GLOBE protocols that will help them to study the phenomenon in an ecosystem-integrated way. They will learn to distinguish which protocols are appropriate for each type of event according to its characteristics. They will analyze the likely consequences of these events and how they can affect a community.

Student outcomes

- To learn to identify and use different sources of information to study natural events.

- To identify possible causes and impacts of natural events on the community.
- To identify possible natural events that could affect their place.
- To relate GLOBE protocols to study natural events in their community.
- To develop models or drawings that represent the events and their impacts (before and after).

Introduction

A natural phenomenon is any manifestation, event, fact or occurrence derived from nature (International Strategy for Disaster Risk Reduction (www.eird.org/fulltext/ABCDisasters/glossary/home.htm#naturalphenomenon)
Due to inclement weather, natural hazards and disasters, and some natural events or phenomena that occur occasionally, such as eclipses, the environment can be changed or affected momentarily or permanently.

Natural hazards are defined as a natural or human-caused phenomenon or process that can endanger a group of people, their things and their environment, when they are not forewarned according to the ISDR. They can become a natural disaster, compromising the health and even the lives of the people who inhabit the place. A disaster is, according to the United Nations (2016), the serious disruption of the functioning of a community or society on any scale due to hazardous phenomena that interact with the conditions of exposure, vulnerability and capacity, causing one or more of the following: human, material, economic and environmental losses and impacts.

These events provide us with the opportunity to make observations and measurements that can later be consulted and used as historical data records, and also to compare them with a time of the year when these events do not occur in order to understand how these events can impact a region or country and the magnitude of the impact. Currently, it is necessary to recognize the risk and its factors in order to determine the procedures to be used (academics) due to the knowledge of the space where one lives (Abarca, 2019).

All these accumulated data will be useful for the processes of nature, their dimension, and when there is a risk of their occurrence, to be able to take preventive or mitigation measures once they have happened. Prevention plays a fundamental role in avoiding major destruction, damage to life and property, which takes a lot of economic and material resources to replace, especially in very vulnerable communities. Starting to deal with these issues at school is fundamental to acquire awareness, to be prepared and to spread the word to the rest of the community.

Some natural hazards are described next:

Avalanches: These occur when huge layers of snow break off the mountainside and shatter like broken glass as they hurtle downhill. These moving masses can reach speeds of 80 miles per hour in about five seconds. Avalanches are most common during and after 24 hours following storms that discharge 30 centimeters or more of fresh snow. This rapid pile-up overloads the accumulated snow, causing a weak layer under the large slab to fracture. The way the layers stick together will determine how easily one layer weakens and causes a slide (National Geographic).

Droughts: Period of time (months-years) during which an area of land suffers from a lack of rainfall. They cause serious damage to soil, crops, animals and even people, sometimes resulting in death (ISDR).

Earthquakes or telluric movements: These are Earth tremors produced by forces acting inside the planet. They are caused by the collision of tectonic plates, which are fragments of the lithosphere (the most superficial layer of the earth) that move as a rigid block, without internal deformation of the asthenosphere (layer immediately next to the lithosphere, which is located between 100 and 240 km below the surface). Another cause is the reorganization of the components of the earth's crust.

Floods: They are caused by the overflowing of a river due to rainfall, tropical storms, hurricanes, and sometimes by human actions, such as deforestation, the location of housing in low-lying areas and near rivers or in known flooding sites (ISDR).

Forest fires: Phenomenon that occurs when one or several combustible materials in forests, jungles and other vegetation areas are consumed in an uncontrolled manner by fire, which can get out of control and spread very easily over large areas (ISDR).

Hail: Frozen water falling from clouds in the form of grains of different sizes is called hail. It is a precipitation different from snow, which descends as flakes. Hail is a solid precipitation. It is composed of small ice spheres, usually between 5 and 50 millimeters in diameter. For hail to form, solid particles are carried by the rising winds into the cumulonimbus, where water particles adhere to them. As these particles ascend, the temperature drops and freezing occurs. Once the hail is formed, when it reaches the upper sector of the cumulonimbus, it falls towards the surface due to its weight (Definicion.de).

Hurricanes: Strong winds originating from the sea and rotating in large whirlwind-like circles, accompanied by rainfall. They are also called tropical cyclones. According to the Beaufort scale, the hurricane storm or hurricane is classified grade 12, and winds reach more than 118 km/h, produces abundant destruction and rain, gigantic waves over 14 m and completely null visibility.

Land subsidence: In geology, subsidence is described as the gradual and progressive downward settlement of the land surface in the absence of horizontal movements. In a simple way we could refer to the process as the gradual subsidence and collapse of the ground. Among the natural causes of land subsidence are permafrost thawing, karst phenomena such as the dissolution of limestone soils, oxidation of organic soils or the sinking of calderas or lava galleries of a volcano, among others. There are also man-made causes (National Geographic).

Landslides: Soil, rocks and vegetation that slide quickly or slowly downhill because the soil is not firm enough. They occur mainly during the rainy season or during seismic activity (ISDR).

Plagues: A major calamity that afflicts a village or community, e.g., large numbers of insects or animals that can destroy crops.

Snow and ice storms: A blizzard or snowstorm is a long-lasting storm with very strong winds and heavy snowfall. To have a snowstorm you need: cold air at the surface, large amounts of moisture and warm air rising above the cold air. An ice storm is a type of winter storm caused by freezing rain. The weather services define it as a storm that results in the accumulation of at least 0.25 inches of ice on exposed surfaces (Biopedia).

Tornadoes: Violent, rotating gusts of wind that spin over the earth. Also defined as a strong, funnel-shaped windstorm that rotates over the ground in a narrow path (ISDR).

Tsunamis: A series of giant sea waves caused by earthquakes, volcanic eruptions or submarine landslides. Tsunamis are also called tidal waves (ISDR).

Volcanic eruptions: Explosions or emanations of lava, ash and toxic gases from the earth's interior through volcanoes (ISDR).

There are also other types of natural phenomena that do not represent a natural threat and are occasional events, such as solar or lunar eclipses, sandstorms that cross the Atlantic bringing dust from the Sahara Desert to the Caribbean and the northern coasts of South America, and others. It is of extreme interest to study them, since their effects transcend a region or continent, and cause effects in other regions of the earth.

Sahara Sands: This phenomenon occurs because winds move, for more than 8,000 kilometers, about 14 million tons of particles from the Sahara Desert to Central America, the Caribbean and part of South America. It happens every year at the beginning of summer due to the action of the trade winds. While these particles affect air quality and, therefore, people's health, these clouds of sand or desert dust provide a good amount of minerals, mainly iron and phosphorus in the soils of the Amazon (Sustainable Territories, 2021).

Eclipse: occurs when a planet or moon gets in the way of the sunlight. We can experience two kinds of eclipses: solar and lunar. A solar eclipse occurs when the moon gets in the way of the sunlight and casts its shadow on the Earth. That means that during the day, the moon moves in front of the sun and it becomes dark. In a lunar eclipse, the Earth prevents the sunlight from reaching the moon. That means that at night, the full moon disappears completely, as the Earth's shadow covers it (NASA Science, 2022).

Guiding Research Questions

- Have any of these events occurred or are they likely to occur in your region?
- What are the most important natural events affecting your community?
- What environmental variables can be studied about them?
- How can they affect human or animal health?
- Could preventive and/or mitigation measures be implemented so that their impact does not greatly affect the community? Which ones?
- In order to study the event, what protocols would you choose that would allow you to measure the environmental consequences of the event?

Scientific Concepts

- Natural hazards and disasters
- Environmental and health impacts
- Environmental hazards
- Vulnerability
- Prevention / Mitigation

Materials and Tools

- Laptop with internet connection
- Colored pencils or markers
- White sheets of paper
- Depending on the event chosen, e.g. for flooding of a watercourse you will require:
    - a square or rectangular container to simulate a river bed, stones, soil, moss or grass, sticks, a jug of water, cell phone or camera

What to Do and How to Do It

Activity 1

Beginning –

- To learn more about the environment and know exactly if any of these events can happen in the locality of the educational center in question, one of the measures that can be taken is to study the place, its characteristics, how it is affected by the climate and other factors (sometimes also affected by the human factor). Some events can be foreseen, and others cannot, but we can study different environmental variables around any of them. To do this, you will choose two of the events described above, and taking a map of the region, you will identify the place of potential "risk" or a place where the event has already occurred.
- You will look for historical information, press releases on the internet about these events, before and after pictures, etc. Also, if it has been a recurring event, investigate when, how many times it occurred and what consequences it produced (for example, the eruption of a volcano, the flooding of a river that passes along the local riverbank or a tsunami that has reached the coast).
- A local expert can visit the school and explain to the students what the event consists of, what its (possible) causes are, what we should consider or anticipate when it occurs, and what its potential consequences and risks (negative and/or positive) are in order to know how to mitigate them.

Development –

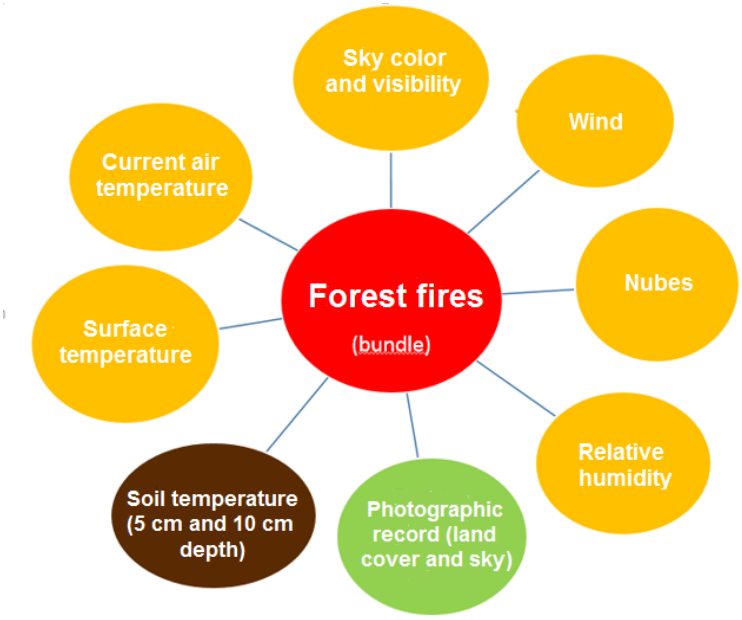
- Ask students to draw two scenarios or build two models of such an event, for example, the scenario before an avalanche (the calm mountain landscape) and the one after it happens.
- The teacher will ask them to reflect on the potential damage that could occur and what preventive measures could be taken to minimize its effects.
- Possible questions for students: What was the area like before the event? What happened during and after the event? What happened to the rocks, trees, animals and vegetation? What about the soil? What would have happened if there had been crops or villages in the affected area?
- Afterwards, work with them on the concepts of vulnerability, mitigation and prevention. It is important to raise awareness and work on prevention with the students, especially in those areas that imply an imminent or very probable risk, in order to minimize the risks in their schools, homes and community in general.

Time: 45 minutes. An additional class in case of a visit from an expert.

Activity 2 (Advanced level)

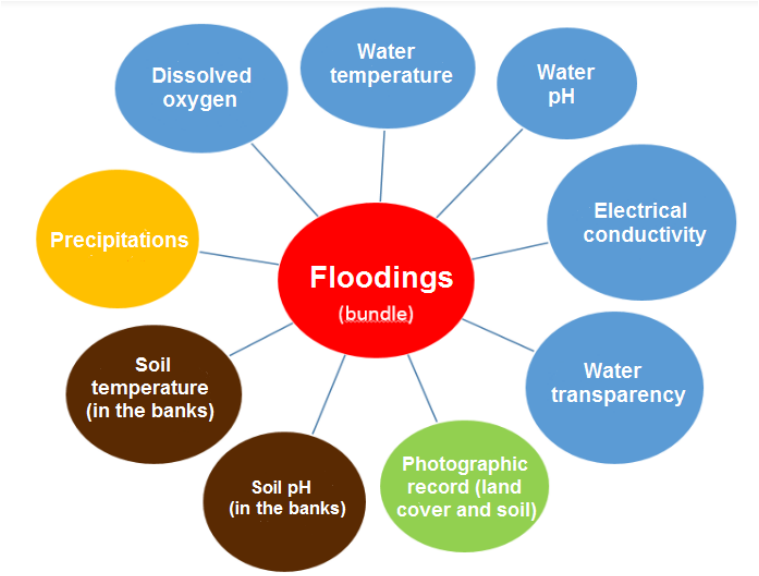
- In the next class you will discuss examples of how an event can be analyzed from the approach of a group of protocols known as the GLOBE protocol bundles.
- You will either provide examples that can be associated with each of the two events that were worked on in the first class or simply choose others. A protocol bundle is defined as "a group of recommended GLOBE protocols". After presenting the examples, allow time for students to discuss whether they find them appropriate or what other bundle they suggest for studying such event.

Example 1. Bundle of suggested protocols to study a forest fire.

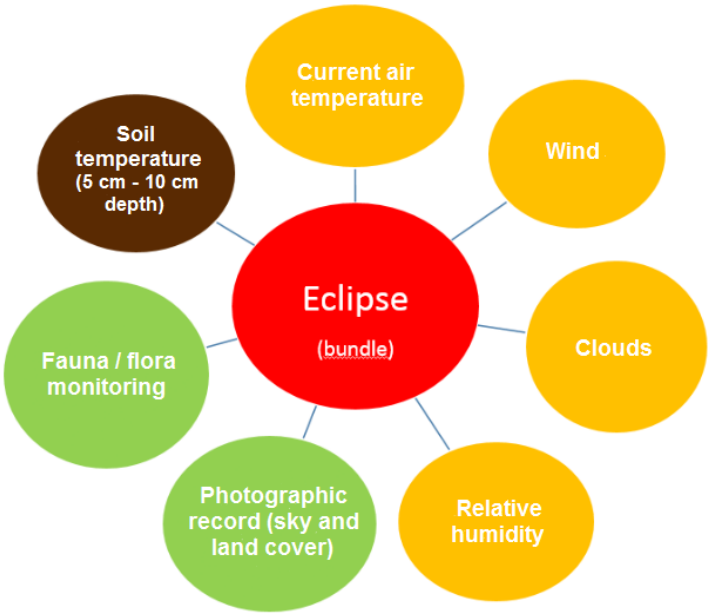


During the event, and as long as it is safe, all protocols can be performed in a nearby area, except for Soil Temperature. When the area has cooled and is safe, Soil Temperature can be added to the other protocols.

Example 2. Flooding of an area that is known from previous flooding events. Bundle of suggested protocols in normal flood season and after flooding has occurred and it is safe to approach the area:



Example 3. Eclipse. The same protocol bundle will be applied for 3 days: the day before, the day of the eclipse and the day after.



Note: Monitoring of fauna or flora species includes birds, domestic animals, sunflowers (Helianthus annuus), sunbeams (Lampranthus) and some other species that experience changes in the absence of sunlight.

Brown code: protocols corresponding to the Soil

Yellow code: protocols of the Atmosphere

Light blue code: protocols of the Hydrosphere

Green code: protocols of the Biosphere

- Students will then be asked to break into groups and take one of the examples of natural events and propose what protocols could be applied in that case, e.g., the arrival of the Sahara sands.

Ending –

- Each group will present their bundle of suggested protocols to the class and discuss with the other groups whether or not this set of protocols is adequate to study the event, which would be the correct ones, which would be the protocol that cannot be missing in this bundle, in what order they would apply them, etc. They should detail how often they will make the measurements, what instruments they will need, how they will organize themselves to make the measurements and recordings, etc.

Frequently Asked Questions

Can we address these events by studying a single protocol or with the tools we have at our disposal?

Yes, of course, the protocol bundles are a proposal to approach the subject with an integrated view of how it affects the entire environment, which is not a fragmented view of reality, approaching it only from the atmosphere or only from the ground, understanding the Earth as a system. If you have only one or two instruments, try to approach the protocols you can with them, and perhaps later you can incorporate other protocols for further study.

Suggested Resources for Further Information

https://espanol.epa.gov/espanol/desastres-naturales

Natural Disasters Video: https://www.youtube.com/watch?v=HdO02KGD86U

Bibliography

Abarca, F. y Lizana, F. (2019). *Educación sobre riesgo de desastres. Métodos didácticos en la enseñanza sobre tsunamis en Chile. Espacios:* Revista de Geografía, 9(18), 55-66. https://doi.org/10.25074/07197209.18.1555

Biopedia. (s.f.). https://www.biopedia.com/tormenta-de-nieve/

Definicion.de. (s.f). *Definición de granizo*. www.definicion.de/granizo/

EIRD y UNICEF. *¡Aprendamos a prevenir los desastres! Los niños y niñas también participamos en la reducción de riesgos*. Costa Rica.

Estrategia Internacional para la Reducción del Riesgo de Desastres. (s.f.) *Los fenómenos naturales y los desastres*. https://www.eird.org/fulltext/ABCDesastres/teoria/desastres.htm

Etecé. (s.f.) *Qué es un tornado*. https://www.caracteristicas.co/tornado

Naciones Unidas. Asamblea General. (1 de diciembre de 2016). *Informe del grupo de trabajo intergubernamental de expertos de composición abierta sobre los indicadores y la terminología relacionados con la reducción y el riesgo de desastres.* [EPub]

National Aeronautics and Space Administration. (2022). *Space Place*. NASA Ciencia. https://spaceplace.nasa.gov/eclipses/sp/#:~:text=Un%20eclipse%20se%20produce%20cuando,eclipses%20solares%20y%20eclipses%20lunares

National Geographic. (s.f.) *Avalanchas*. https://www.nationalgeographic.es/medio-ambiente/avalanchas

National Geographic España. (s.f.) *Cuando el suelo se hunda bajo nuestros pies*. https://www.nationalgeographic.com.es/ciencia/subsidencia -cuando-suelo-se-hunda-bajo-nuestros-pies_16206

Territorios Sostenibles. (s.f.). https://territoriossostenibles.com/calidad-del-aire/arenas-del-sahara-afectaran-de-nuevo-calidad-del-aire-en-colombia#