NOVA®

Original broadcast: November 25, 2003

Volcano Above the Clouds

PROGRAM OVERVIEW

NOVA joins climbers scaling Mount Kilimanjaro as they travel through ecosystems ranging from a cloud forest to a glaciated mountaintop.

The program:

- chronicles the quest of naturalist Robin Buxton, who was disabled by polio in childhood, to reach the top of Africa's highest mountain.
- features specially adapted plants that grow in cold and high altitudes.
- describes the danger that Mount Kilimanjaro could suffer a landslide, like Mount St. Helens in Washington, that triggers a catastrophic eruption.
- shows how scientists take temperature readings in the volcano's crater to help them predict how far below the surface the magma lies.
- follows scientists as they search for the source of fresh water found at the mountain's base.
- reveals how warm air from the volcano and global warming may be contributing to the evaporation of Mount Kilimanjaro's glaciers, which could disappear within 20 years.
- concludes that the glaciers are not the source of the fresh water found at the base of mountain.

Taping Rights: Can be used up to one year after the program is taped off the air.

BEFORE WATCHING

1 Define the word "ecosystem" for your students. (An ecosystem comprises the interactions among populations in a community and their physical surroundings.) Ask students to provide examples of local ecosystems.

2 Have students locate Mount Kilimanjaro on a map. Ask students what they think the climate would be like there. Do students think that ecosystems would be different between the base of the mountain and its peak? Assign students to take notes on the areas listed in the "Climbing Kilimanjaro" activity on page 2.

AFTER WATCHING

1 Group dynamics play an important role in research expeditions. Ask students to give examples from the program of times when the group's ability to work together was important to reach its goal or to ensure the survival of group members. (Examples may include times when the porters disagreed about how to put up the tent, when the porters decided to take turns carrying Robin, when Robin decided to turn back rather than continue to the summit, or when the leaders decided how early they should set out or what route to take.)

CLASSROOM ACTIVITY

Objective

To develop a travelogue to describe the distinct ecological regions of Mount Kilimanjaro.

Materials for each group

- copy of the "Climbing Kilimanjaro" student handout
- access to print and Internet resources for research

Procedure

1. Mount Kilimanjaro, in Tanzania, Africa, is home to distinct ecological regions, including rain and cloud forest, heath and moorland, alpine desert, and glacier environments. In this activity, students create a travelogue that describes the geological, climatic, and biological features of the different regions.
2. Organize students into groups and distribute the "Climbing Kilimanjaro" student handout. Tell students that they are part of a larger team that is climbing Mount Kilimanjaro. Their group's role is that of team recorder, and they should create a travelogue that describes the ecology and climate of the different regions of the mountain. In addition, the travelogue should describe the health issues that may affect climbers, and any necessary equipment or safety precautions that the team may need at each stage of the climb.
3. As they watch, have students take notes about the different regions of Kilimanjaro listed on their student handout. Assign each group, or each student in a group, to take notes about a certain section of the climb.
4. After watching, students should use print and Internet resources to complete their research and create their travelogues.
5. Conclude by having teams present their travelogues. Encourage a class discussion about what makes each region unique and what characteristics might be necessary for animals and plants to survive in the different environments.
6. As an extension, ask students to add a section to their travelogue that discusses why scientists are interested in Mount Kilimanjaro. They can draw their answers from the program and from the article "Mount Kilimanjaro: One Mountain, Five Climates" found at forests.org/articles/reader.asp?linkid=9833

STANDARDS CONNECTION

The "Climbing Kilimanjaro" activity aligns with the following National Science Education Standards.

GRADES 5–8
Science Standard C:
Life Science
Populations and ecosystems

- A population consists of all individuals of a species that occur together at a given place and time. All populations living together and the physical factors with which they interact compose an ecosystem.
- The number of organisms an ecosystem can support depends on the resources available and abiotic factors, such as quantity of light and water, range of temperatures, and soil composition.

GRADES 9–12
Science Standard C:
Life Science
The interdependence of organisms

- Organisms both cooperate and compete in ecosystems. The interrelationships and interdependencies of these organisms may generate ecosystems that are stable for hundreds or thousands of years.
- Living organisms have the capacity to produce populations of infinite size but environments and resources are finite. This fundamental tension has profound effects on the interactions between organisms.

Video is not required for this activity.

Classroom Activity Author
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ACTIVITY ANSWER

Students' descriptions of each region may include the following features and characteristics:

Rain and Cloud Forest (6,000 feet to 9,000 feet)

Rain forests are very dense, warm, wet forests. The temperature generally ranges between 70°F and 80°F throughout the year, and the forest area may have between 40 inches to 80 inches of rain per year. At about 8,000 feet, a layer of cloud often forms, which blankets the forest throughout most of the day. These clouds are an important source of water for the areas below the mountain. A thin layer of poor soil covers a thick layer of clay on the forest floor. There are a number of different tree species in the forest, and many grow between 130 and 165 feet tall. The branches of the trees interlock to form a canopy above the forest. Mosses, lichens, ferns, and orchids are other common plants. The forest supports a variety of wildlife including colobus and blue monkeys, bushbuck, duikers, lions, leopards, and bush pigs.

Heath and Moorland (9,000 feet to 13,000 feet)

Above the forest line, porous soils and lower rainfall result in much sparser vegetation. The lower altitudes of this region are characterized by a wide, rolling meadow with giant heath plants and many small wild flowers. Heavy mists often cover the area. These areas may get about 30 or 40 inches of rain a year. At higher altitudes, the region is much drier, getting only about 20 inches of rain per year. There is also a greater fluctuation in temperature, with high temperatures during the day, and freezing temperatures at night. This region has several distinct plants, including dwarf camphor trees and giant lobelia and senecio (groundsel). The lobelia grow up to 10 feet high, have hollow stems, and tall flower-like spikes. In order to protect the sensitive leaf buds from the nighttime temperatures, the lobelia close their leaves around the central core, while secreting a slimy antifreeze-like solution. The giant groundsel can reach 16 feet high with a crown of large leaves and a 3-foot long spike of yellow flowers. The groundsel uses its old dead leaves as insulation around its trunk. There is not much wildlife in this region because of the altitude, although wild dog, eland, and lion have been found.

Alpine Desert (13,000 feet to 16,500 feet)

This is a harsh, dry, windy region, consisting mostly of bare rock and ice. The temperature of the area ranges from below freezing at night to 85°F during the day. The air is very thin, and radiation from the sun is intense. It rains less than 10 inches per year, so there are very few plants, mostly lichens and small mosses. Only a few birds, such as raven and other large birds of prey, can survive in this region, along with several small rodents. At certain times of the year, snow covers the area.

Summit (16,500 feet and up)

The summit is an arctic zone characterized by freezing cold nights and burning sun during the day. This region receives less than 4 inches of precipitation per year, usually in the form of snow. The oxygen level in the air is half that of sea level. Barren volcanic debris and volcanic craters cover the ground. There is no animal life in this region, and only a few stunted lichens. Just below the summit are glacier cliffs with carved walls. However, the glaciers are disappearing at such a rapid rate that there is concern that the ice cover may disappear completely within the next 20 years.

Equipment and Safety Issues

Climbing Mount Kilimanjaro involves preparing for conditions ranging from tropical to arctic with extremely high winds and subfreezing temperatures. Important equipment includes food and water, multiple insulating layers of clothes, sturdy rain gear, alpine sunglasses, sun block, aspirin, sturdy hiking boots, and camping equipment. In addition, altitude sickness can occur at high altitudes, due to the inability of the human body to adjust to a rapid gain in altitude. Symptoms of altitude sickness include loss of appetite, headache, nausea, vomiting, exhaustion, weakness, a rapid pulse even at rest, insomnia, swelling of hands and face, and reduced urine output. Climbers with severe symptoms must stop ascending and consider descending to a lower altitude. A slow pace, drinking lots of fluids, and certain medications can prevent or reduce the severity of altitude sickness.

LINKS & BOOKS

Links

NOVA Web Site—Volcano Above the Clouds
www.pbs.org/nova/kilimanjaro/
In this companion Web site for the NOVA program, find out how Earth's glaciers are holding up, see a map of the planet's ecological zones, learn about each of the tallest summits on the seven continents, and discover why mountains make their own weather.

Crown of Africa: Unlocking the Secrets of Kilimanjaro
www.altrec.com/features/crowno-fafrica/
Includes information on the mountain's climates, geology, and routes, as well as equipment and safety precautions.

Kilimanjaro and Other Mountain Areas
www.kilimanjaro.cc
Gives detailed descriptions of the climbing routes up Kilimanjaro, as well as additional information on the mountain's geology, glaciers, plant life, animal life, and weather.

Kilimanjaro National Park General Information
www.habari.co.tz/tanapa/kilpakg.html
Provides general information about such things as the history, climbing routes, and climate of Mount Kilimanjaro.

Passport to the Rainforest
www.passporttoknowledge.com/rainforest/main.html
Includes sample travelogues from high school students who visited the Amazon and Costa Rica.

Book

Salkeld, Audrey.
Kilimanjaro: To the Roof of Africa.
Washington, D.C.: National Geographic Society, 2002.
Follows the weeklong journey of five trekkers and a guide to the top of Kilimanjaro. Includes extensive photographs, descriptions of the mountain's geological origins, flora and fauna, and history.

Major funding for NOVA is provided by the Park Foundation, Sprint, and Microsoft.

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Climbing Kilimanjaro

Mount Kilimanjaro, located in Tanzania a short distance from the equator, is the world's tallest volcano and the tallest mountain in Africa. Climbing the 19,340-foot mountain takes you through distinct ecological regions, such as:

- rain and cloud forest (6,000 feet–9,000 feet)
- heath and moorland (9,000 feet–13,000 feet)
- alpine desert (13,000 feet–16,500 feet)
- glacier (16,500 feet and up)

Each region has its own climate, physical features, plants, and wildlife. Mount Kilimanjaro is the only mountain in the world to offer such a diverse environment along its slopes. You and the other members of your group are charged with writing a travelogue about this unique mountain.

Procedure

1 Watch NOVA's "Volcano Above the Clouds" in class and take notes on the various ecosystems found along Kilimanjaro and the equipment needed to scale the mountain.

2 Use additional resources for researching and describing each stage of the climb. Include any illustrations, maps, or diagrams you think might be useful. You may want to use the questions below as a guide.

3 Write a travelogue that describes the different regions encountered during the climb, as well as the equipment needed and health issues faced during each stage of the climb.

Some Travelogue Questions

- What are some of the physical characteristics of the region?
- What kind of weather might you encounter in this region?
- What kinds of animals and plants can be found in the area?
- Do those plants and animals have any special adaptations to the conditions in the region? If so, what are those adaptations?
- Is there any special equipment you might need for this stage of the climb? If so, what equipment do you need?
- Are there any health or safety precautions you should be aware of for this stage of the climb? If so, what are they?
- Why might scientists wish to study this region in more detail?