

Perhaps Earth's earliest humans gazed upon the many wonders of Kilimanjaro. Africa's tallest mountain and the planet's highest freestanding mountain, Kilimanjaro towers above the East African plain. Its highest summit is 5895 meters. It is so massive that its weight measurably depresses the crust of the Earth. Kilimanjaro is a dormant volcano (actually three), with its last eruption occurring 100,000 years ago. It is located in the country of Tanzania, near the equator, along Africa's Great Rift Valley.

Climbing Kilimanjaro means passing through five climatic zones, including rainforest, heath, moorland, alpine desert, and arctic. Temperatures range from 85 degrees Fahrenheit to below zero. Every year, 15,000 people attempt to reach the summit of Kilimanjaro and almost half fail. But, the real adventure of climbing Kilimanjaro is in making the journey – regardless of whether or not the summit is reached.

The Making of the Large-Format Film

Driving this film is the dream of capturing the dramatic sweep and beauty of Kilimanjaro for the giant screen. Accomplishing this feat is David Breashears, one of the world's leading adventure filmmakers. With *Kilimanjaro*, Breashears returns to the high-altitude environment where he feels most at ease and to a subject exceptionally suited to his filmmaking talents.



"Filming *Kilimanjaro* was a tremendous challenge; we had to climb the mountain four times to get the shots we needed. But it's been very rewarding as well. We want people who will never go there themselves to experience the wonder and magic of Kilimanjaro."

– David Breashears



FILMING STATS

Crew members	9
Porters	120
Camera porter team	15
Trekking group	7
Weight/film	500 lbs.
Weight/equipment	1200 lbs.
Overall weight carried	7200 lbs.

Each porter carried 60 lbs.

It took 11 days of climbing and 120 porters to film *Kilimanjaro*. Normally a four- or five-day climb, the extra trekking time allowed for a slow acclimation to decreasing oxygen levels during the ascent, and also for more observation time. What you will see in this film is the story of a journey – a journey of courage and endurance – from the lower rainforest reaches of Kilimanjaro to the arctic glaciers at the summit. Along the way, the trekkers experience five climatic zones, encounter elephant bones high up the mountain, and see strange landscapes that remind one trekker, Nicole Wineland-Thomson, of a Dr. Seuss book: "It was beautiful and it sort of felt like I was in Dr. Seuss land because the trees are so bizarre looking."

Experience the trekkers' fears and aspirations as you see the mountain through their eyes!

For more information on *Kilimanjaro*, please visit www.hmns.org (click on film distribution). You will find updated information on the film, including where it is being shown in theaters.



Kilimanjaro is a David Breashears film produced by Kilimanjaro Inc. in collaboration with the Houston Museum of Natural Science; the Denver Museum of Nature & Science; Museum of Science, Boston; and Omaha's Henry Doorly Zoo.

KILIMANJARO

Great Rift Valley – Kilimanjaro's Beginnings



Dr. Roger Bilham, Geologist

The Great Rift Valley in Eastern Africa is one of the planet's most dramatic features. It is a 6500-kilometer-long fissure in the Earth's crust – equivalent to one-sixth of the Earth's circumference! Stretching from the valley of Jordan in the north to Mozambique in the south, the rift is visible from the Moon. Some of the world's most spectacular but least known volcanoes are found on or near the Great Rift Valley, where over 100 eruptions have occurred in the last 150 years.

"I'm here in the middle of this incredibly lush forest, but actually I'm sitting on the volcano with a half mile of volcanic rock beneath me."

– Roger Bilham

Kilimanjaro is a massive stratovolcano located alongside the Great Rift Valley in Tanzania. Enormous forces beneath the Earth's surface forced molten lava to the surface and created pyroclastic volcanic eruptions to form Kilimanjaro. There is evidence that the rift is still in progress along the Great Rift Valley. Kilimanjaro is considered a dormant volcano, not an inactive volcano. At the mountain's highest peak, Kibo, there is an icy mile-wide crater surrounded by sulfuric steam.

Without the violent eruptions of the past, the rich grasslands around Kilimanjaro would not exist. Water percolates through the rich volcanic soil to create land prime for cultivation.

Mapping Activity

Where in Africa is Kilimanjaro? Enlarge the map of Africa. Use maps and/or the internet as references for this activity.

On the map, indicate the location of Kilimanjaro, a dormant volcano in Tanzania. Indicate the locations of other volcanoes in Tanzania: Mt. Meru, Kerimasi, Ketumbeine, Ngorongoro Crater, and Ol Doinyo Lengai, the youngest and most active among the Tanzania volcanoes, which erupts about every decade.

Identify the Olduvai Gorge, an area where early human fossils have been found.

Identify Lake Natron at the foot of Lengai. This is the most poisonous lake in Africa, due to the mineral runoff. As the lake evaporates, the mineral salts concentrate. Only algae lives here. The only animal that can harvest the algae is the flamingo, which flocks here in the millions. The lake provides a safe place for these birds to nest and raise chicks.



Africa today



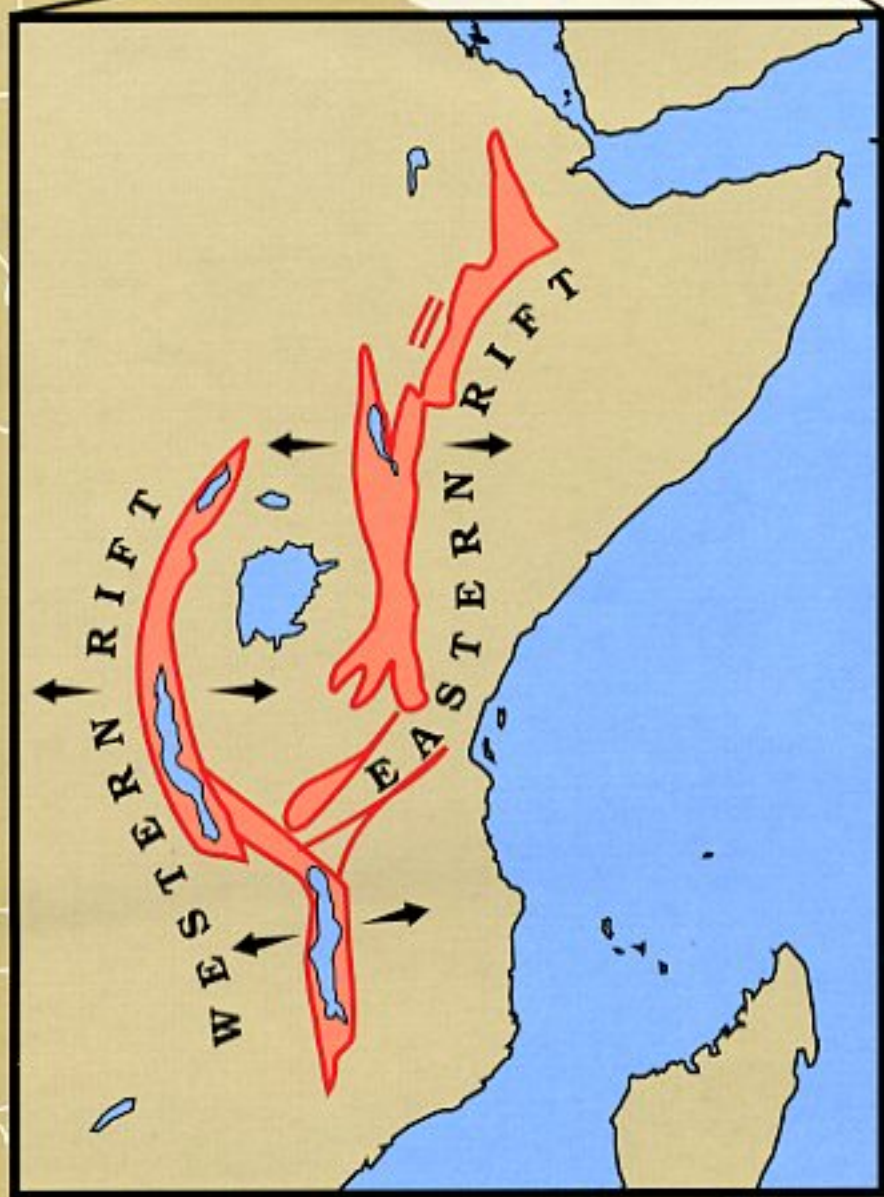
Africa in the distant future

Extension

The Great Rift Valley has already been responsible for pushing Saudi Arabia off the African continent. Because of the continuing action of the Great African Rift, Africa could look considerably different in the distant future. How do you think Africa will look? Draw your prediction in the box at left.

KILIMANJARO

GREAT RIFT VALLEY



Kilimanjaro is a David Breashears film produced by Kilimanjaro Inc. in collaboration with the Houston Museum of Natural Science; the Denver Museum of Nature & Science; Museum of Science, Boston; and Omaha's Henry Doorly Zoo.

KILIMANJARO

The Trek Team of Kilimanjaro

In choosing the trek team, the *Kilimanjaro* producers sought engaging individuals with wide-ranging interests, ages, nationalities, and backgrounds. The goal was to appeal to a broader audience by presenting the wonders of Kilimanjaro through the eyes of youngsters, such as the 13-year-old African boy and 12-year-old American girl, as well as more experienced individuals, such as the 55-year-old science professor and 64-year-old writer and historian.



Jacob Kyungai

Leading the trek team and narrating the film is Jacob, 50, a Chagga mountain guide who has climbed Kilimanjaro over 250 times. With a lifelong connection to the mountain, he has always lived at its base in Machame village. On his small farm, he raises cows and chickens and grows coffee and corn in the fertile volcanic soil. The mists that blanket the rainforest of Kilimanjaro help water his crops. Jacob helped design and construct some of the mountain routes. During the Kilimanjaro team's ascent, he shared his knowledge of flora and fauna in the various climate zones.



Nicole Wineland-Thomson

Nicole, 12, lives with her family in Massachusetts. She loves to ride horses, hike, and tackle the walls at an indoor climbing gym. She also is a seasoned world traveler, thanks to her parents' safari business. After she saw the ice-capped summit of Kilimanjaro for the first time and heard her father's tales of ascending to its peak in 1979, Nicole vowed to climb the mountain herself. There aren't many girls of 12 who have climbed to the roof of Africa, and none but Nicole have overnights in the crater at 18,700 feet.



Hansi "Hansi" Mmari

A member of the Chagga tribe, Hansi, 13, lives with his family just outside the town of Arusha, where he can see Kilimanjaro 20 miles in the distance. He excels in math, plays soccer, is accomplished on the computer, and speaks English as fluently as he does Swahili. His father's experiences climbing Kilimanjaro fired up Hansi's imagination. Throughout the journey, he displayed remarkable tenacity and willingness to learn, taking a keen interest in the science of the volcano and in the IMAX camera.



Audrey Salkeld

Audrey, 64, is an award-winning writer and historian, largely on the subject of mountaineering. Currently at work on a National Geographic Society book about Kilimanjaro, she coauthored *Last Climb: The Legendary Everest Expeditions of George Mallory* with David Breashears. Audrey lives in Cumbria, England. Although she has spent her career traveling to the mountains of the world, she had never climbed a peak as high as Kilimanjaro.



Heidi Albertsen

A native of Denmark, Heidi, 23, is a successful model and an avid painter. She grew up taking camping trips to the Alps with her family and developed an abiding fascination for mountains and adventure. Throughout the expedition, her extroverted nature inspired her comrades. No matter how thin the air grew or how high the team ascended, Heidi's energy never flagged as she sketched, painted, wrote, and photographed her way to the top.



Roger Bilham, Ph.D.

Born in England, Roger, 55, is now based at the University of Boulder in Colorado. A leading authority on earthquakes, volcanoes, and tectonic plate movement, he has studied the movement of East Africa's Great Rift Valley for years. A born teacher and communicator, the professor inspired and taught the two youngest members of the team with his boundless enthusiasm for the science of mountains.



Kilimanjaro is a David Breashears film produced by Kilimanjaro Inc. in collaboration with the Houston Museum of Natural Science; the Denver Museum of Nature & Science; Museum of Science, Boston; and Omaha's Henry Doorly Zoo.

KILIMANJARO

Scientists at Work on Kilimanjaro

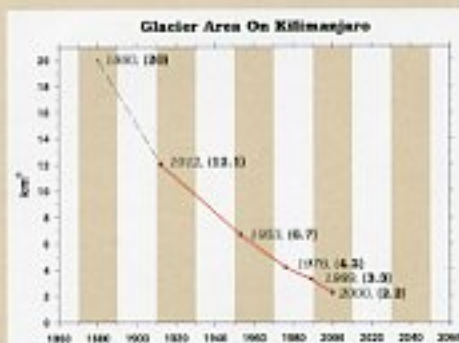
Many of us assume that the ice atop Kilimanjaro is a constant feature. But is it? Until about 1880, glaciers encircled the entire crater of Kilimanjaro. Today, there is considerably less ice on top of the mountain than there once was.



Photo: Jarek Jaffejt, Suzahil Coast.

One way to tell is by comparing photos. Examine the photo to the left, taken in March 2000. Notice the amount of ice on top of the mountain. Now go to www.geo.umass.edu/climate/tanzania/retreat.html and look at the photo taken in March 1974. Do you see the difference in the amount of ice?

Look at the chart to the right, which plots the glacier area from the year 1880 to the year 2000. Notice the decrease in the glacier area over the past 120 years.



What is happening to the ice? Why? Scientists are trying to answer these questions by gathering data.

Meet one of the research teams that studies the ice on top of Kilimanjaro!



Dr. Doug Hardy makes electrical connections at the weather station. Photo: Mathias Vullie, UMass Geosciences.

Dr. Doug Hardy, climatologist at the University of Massachusetts (UMass), led a team that erected a weather station at the top of Kilimanjaro in February 2000. The weather station operates using solar power. It measures and records air temperature, humidity, incoming solar radiation, wind speed and directions, barometric pressure, and changes in the surface height of the ice cap. Several times a day, it sends observations to a UMass computer via satellite transmitter. The weather station is located at 5794 meters above sea level near the summit of Kilimanjaro.

The researchers know that glaciers survive where there is a net accumulation of ice from year to year. But, at this one spot, they found that the ice surface decreased in height by more than one meter after one year, removing many years of accumulation. Some people have speculated that the ice on Kilimanjaro could disappear by 2020 due to rising temperature, or "global warming." Doug Hardy and his team caution against jumping to that conclusion.

Inquiry - Think Like a Scientist!

What questions do you have after reading the above information?

How can scientists find out if a decrease in the glacier area on Kilimanjaro is typical of other tropical locations?

What evidence would you need in order to draw conclusions?

What are some alternative explanations, besides increasing air temperature, that could explain why the ice is decreasing on Kilimanjaro? Understanding the health of glaciers, like that of bank accounts, involves considering both credits and debits. On Kilimanjaro, credit comes from precipitation (snowfall) and the primary debit is sublimation (where energy inputs, such as solar energy, cause vaporization of ice instead of melting). Overall, there has been a negative balance on Kilimanjaro for more than 100 years. Explain how this negative balance could be caused by a change in precipitation.

How are glaciers on other mountains near the equator responding to climate?

There is research being conducted in Tibet and in the Andes. Find out more about this research! Refer to the last panel (at right) for links to more information.



Kilimanjaro is a David Breashears film produced by Kilimanjaro Inc. in collaboration with the Houston Museum of Natural Science; the Denver Museum of Nature & Science; Museum of Science, Boston; and Omaha's Henry Doorly Zoo.

KILIMANJARO

"The climb requires stamina and strength of heart. They won't know they have it until they need it."

- Jacob Kyungai, Leader

Produced and directed by Emmy Award-winning David Breashears of *Everest* fame, this adventure of the human spirit follows six trekkers led by a local Chagga guide as they journey up the mountain through the five climate zones to the summit. On the ascent, the team explores Kilimanjaro's delicate ecosystems and their unique flora and fauna, learning about the formation of the African continent and the Great Rift Valley, as well as Africa's fiery volcanic history. "It's as if we've gone from the Amazon to Antarctica," one team member observes of the climb.



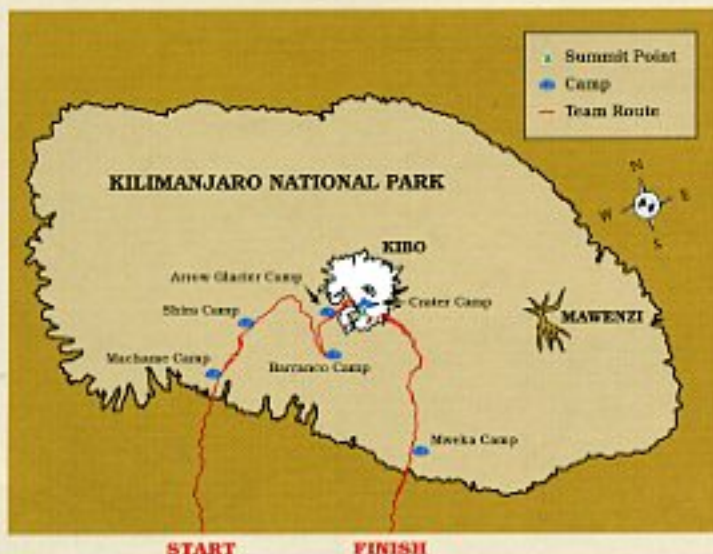
Kilimanjaro is not a challenge for seasoned mountaineers, but for these trekkers the climb will be a test both of their endurance and of their bodies' ability to adjust to the mountain's drastic climate changes. During their 11-day adventure, the trekkers will climb more than 55 miles to a height of over 19,000 feet.

Before you view the film:

1. List five adjectives that describe your idea of what a trek up Kilimanjaro would be like.
2. Research Mt. Kilimanjaro using the internet or other sources. List ten items you would take on a trek up Kilimanjaro. Give reasons for your choice of each item.
3. There are several routes up Kilimanjaro (see resource links for a helpful website). Which one would you take? Why?
4. If you could take five people with you on a trek up Kilimanjaro, whom would you take and why?

After you view the film:

1. Now that you have viewed the film, list five adjectives that describe a trek up Kilimanjaro. Did your list change? Why?
2. Rethink your list of items necessary for a climb up Kilimanjaro. What changed on your list and why?
3. In addition to Mt. Kilimanjaro, what notable sites, animals, plant life, and other interesting observations could you make at Kilimanjaro National Park?



4. Would you change the people that you take along? How might taking a younger person, an older friend, or a teacher affect your experience? Would you want to take people whom you don't know, but who might be fun to get to know during the journey?
5. Nicole wrote an internet diary during her Kilimanjaro trek. Write your own diary of what you think you would experience on a climb up Kilimanjaro.
6. Audrey wrote a poem about the courage she discovered in herself on Kilimanjaro. Write a poem describing how going on your own Kilimanjaro adventure would affect what you know about yourself.



Kilimanjaro is a David Breashears film produced by Kilimanjaro Inc. in collaboration with the Houston Museum of Natural Science; the Denver Museum of Nature & Science; Museum of Science, Boston; and Omaha's Henry Doorly Zoo.

KILIMANJARO

In the Zone

What type of climate would you expect on Kilimanjaro, a mountain near the equator?

Trekking up Kilimanjaro means going from the heat of the equator to the frigid cold of the arctic in just four to six days. Kilimanjaro is a microcosm of many of the world's habitats and climates. Trekkers climb through five climatic zones as they ascend 5895 meters. Climatic zones are regions with generally consistent temperature and precipitation. The first 1800 meters of the mountain was once dense with forests. It is now cultivated with plantations and pastures, as this is an area of heavy rainfall and rich volcanic soils.



1800 to 2800 meters Rainforest Zone

A rainforest belt encircles the lower reaches of Mt. Kilimanjaro. It is the richest zone on the mountain, due to abundant rain. Rainfall is 1000 millimeters per year on the western and northern slopes and 2000 millimeters per year on the southern slopes. The dense canopy harbors brightly colored insects, hornbills, bright flowers, colubus monkeys, and leopards.



2800 to 3200 meters Heath Zone

Thickets of stunted and shrub-like trees are in this gray, meager climatic zone. It's as if you have been transported from the Amazon rainforest to fields of heather in Scotland! There are splashes of color - wild gladiolus, wild iris, wild orchids, and exotic, spiky orange or yellow flowers called "red-hot poker."



3200 to 4000 meters Moorland Zone

The vegetation in this cool, arid zone looks like a Hollywood landscape for a space alien film! Giant groundsel, some more than 200 years old, have cabbage-like leaves that die off and protect the trunk from sub-zero temperatures. Lobelias, squat mounds of green starbursts, close their leaves over their central core at night for protection. Buffalo, elephants, elands, common duikers, and the yellow-crowned canary are just some of the wildlife here.



4000 to 5000 meters Alpine Desert Zone

Nights are below 0 degrees Celsius and daytime temperatures reach over 35 degrees Celsius. Only the hardiest organisms can survive. It is the equivalent of the conditions found north of Canada or in Siberia. Alpine desert plants include lichens, moss balls, and a few tough flowering plants called "everlastings." Not much wildlife lives here, although elands, leopards, and some African hunting dogs pass through. Few birds can cope with the thin air and strong winds, but ravens and large birds of prey forage here.



5000 to 5895 meters Arctic Zone

It's freezing cold at night with a burning sun during the day. There is no liquid surface water. Rain seeps down into the crater or turns into ice. Even in this desolate climate, some red and gray lichens are adapted for survival. The massive glaciers that cover one-third of the mountaintop are remnants of the ice cap that covered the entire summit area thousands of years ago.

Group Learning Activity:

Take a large piece of paper 60 centimeters tall and 400 centimeters wide. Draw Kilimanjaro on the paper, being sure to make its base as wide as the paper and its height as tall as the paper. This represents a scaled model of Kilimanjaro, which is approximately 6 kilometers in height and 40 x 60 kilometers at its base. Cut out the mountain. Trim part of the top to form the caldera, a large circular depression caused by collapsing magma, that exists atop Kilimanjaro.

Convert the above metric measurements for the locations of the five climatic zones on Kilimanjaro from meters to centimeters. Draw each zone on your paper model of Kilimanjaro. Label each zone with its name and measurements. Draw some of the plants and animals that belong to each zone.



Kilimanjaro is a David Breashears film produced by Kilimanjaro Inc. in collaboration with the Houston Museum of Natural Science; the Denver Museum of Nature & Science; Museum of Science, Boston; and Omaha's Henry Doorly Zoo.

KILIMANJARO

National Science Education Standards (U.S.) addressed in these activities:

Content Standard A: Science as Inquiry

- Abilities necessary to do scientific inquiry
- Understandings about scientific inquiry

Content Standard C: Life Science

- Populations and ecosystems

Content Standard D: Earth and Space Science

- Structure of the Earth system
- Earth's history

Content Standard F: Science in Personal and Social Perspectives

- Populations, resources, and environments
- Science and technology in society

Content Standard G: History and Nature of Science

- Science as a human endeavor
- Nature of science

Curriculum Standards for Social Studies (U.S.) addressed in these activities:

Culture: Social studies programs should include experiences that provide for the study of culture and cultural diversity.

People, Places, and Environments: Social studies programs should include experiences that provide for the study of people, places, and environments.

Science, Technology, and Society: Social studies programs should include experiences that provide for the study of relationships among science, technology, and society.

Global Connections: Social studies programs should include experiences that provide for the study of global connections and interdependence.

Resources:

Tanzania Tourist Board official website with interactive map: <http://www.tanzania-web.com/home2.htm>

Kilimanjaro National Park: <http://www.habari.co.tz/tanapa/kilpakg.html#CLIMBING>

Climbing routes: <http://wuzwuz.nulgalway.ie/~mike/mountain/routes.html>

Chaggas - a tale about Chagga children: <http://www.aaronshep.com/stories/024.html>

Geology of Kilimanjaro and landstat images: http://volcano.und.nodak.edu/vwdocs/vole_images/img_kilimanjaro.html?clod=iwm

World climatic zone classification map: <http://hum.amu.edu.pl/~zbrw/glob/glob124.htm>

Climatic zones on Kilimanjaro with information on plants and animals:
<http://www.newafrica.com/nationalparks/tanzania/kilimanjaro.asp>

USGS map of Great Rift Valley with locations of active volcanoes: http://pubs.usgs.gov/publications/text/East_Africa.html

Research on ice melt on Kilimanjaro: <http://www.geo.umass.edu/climate/kibo.html>

University of Massachusetts Kilimanjaro climate research: <http://www.geo.umass.edu/climate/kibo.html>

Ice core research at Ohio State University: <http://www-bpre.mps.ohio-state.edu/icecore/>

Recent glacier retreat on Kilimanjaro: <http://www.geo.umass.edu/climate/tanzania/retreat.html>

Information on the status of glaciers around the world: <http://www.geo.unizh.ch/wgms/>

Information on Kilimanjaro: <http://www.hmns.org> (click on film distribution)

Authors: Martha Kolbe, Manager of X•Plorations, Houston Museum of Natural Science
Pam Wheat, Director of Education, Houston Museum of Natural Science

Advisors: Douglas R. Hardy, Ph.D., Research Assistant Professor, University of Massachusetts
Dan Brooks, Curator of Vertebrate Zoology, Houston Museum of Natural Science
Sharon Dews, Humble Independent School District

Design by Gateway Design, Inc.

Houston
Museum
of Natural
Science



Kilimanjaro is a David Breashears film produced by Kilimanjaro Inc. in collaboration with the Houston Museum of Natural Science; the Denver Museum of Nature & Science; Museum of Science, Boston; and Omaha's Henry Doorly Zoo.