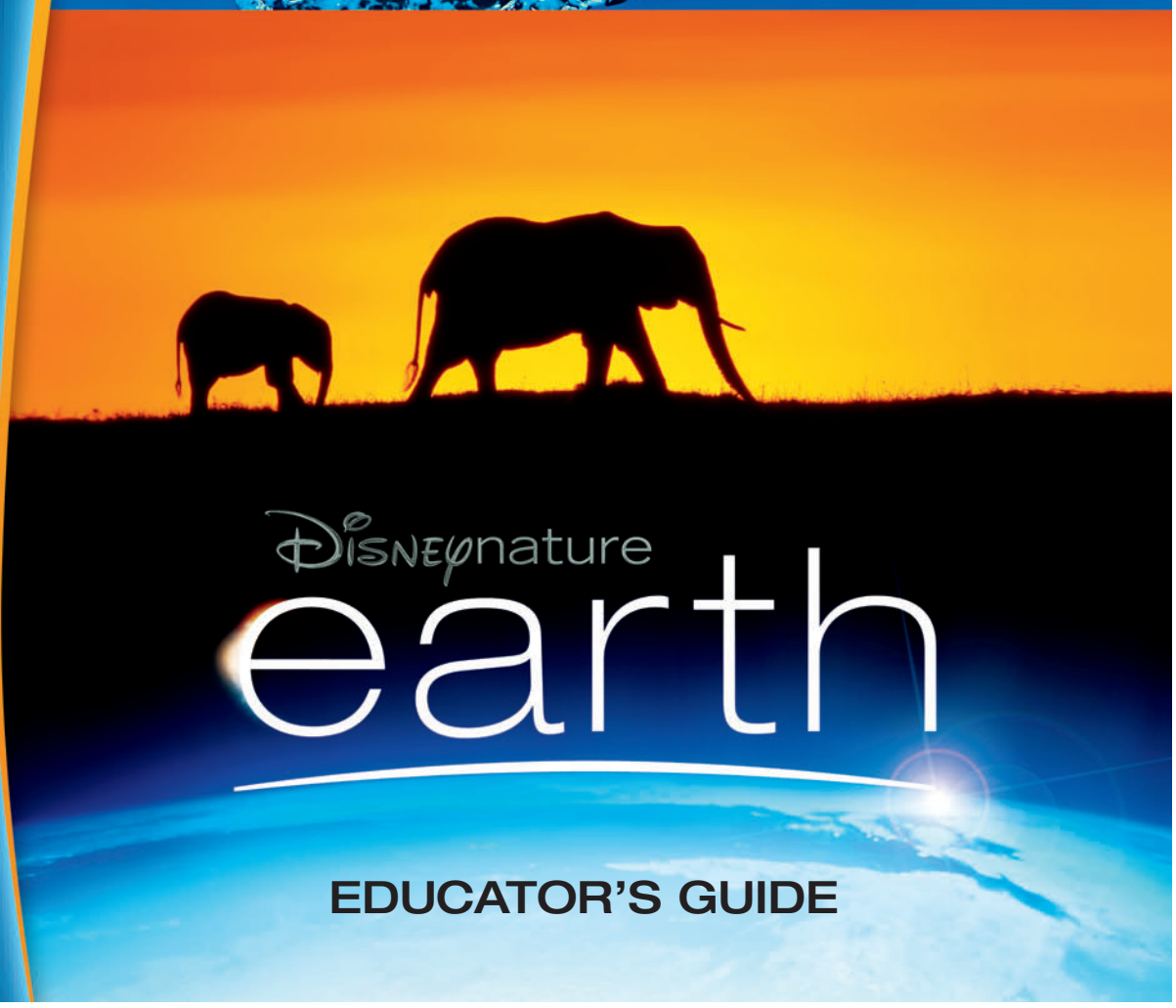

Disneynature

earth

EDUCATOR'S GUIDE

Introduction

earth is an inspiring vision: a glorious celebration of a lucky planet and a unique educational experience. Designed to spark a student's curiosity and imagination with its scale and drama, the film provides a spectacular introduction to key themes of scientific and geographical study.

The educator's guide extends themes the film introduces, supplying background notes and study materials. Five topics have been selected: The Earth and the Sun, The Great Migrations, Adaptation and Habitat, Predators and Prey, and Life Cycles. Each is supported by activities and games, ranging from simple 'just for fun' card games with an educational focus to full-scale science projects involving students in fieldwork within their own locality.

This guide is designed to assist educators in creating materials to harness the educational value of **earth** in their own region. The activities are grouped for different age ranges and can all be adapted up or down the age range to suit local curriculum requirements. Equally, it is intended that educators should select from the suggested activities those that most suit the educational context within which they will be used.

earth gives students the opportunity of a lifetime. It allows them to voyage across their home planet to witness for themselves the astonishing variety and beauty of life in the world they inhabit, and which they will inherit.

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Disneynature earth

EDUCATOR'S GUIDE

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THE EARTH AND THE SUN

NATIONAL SCIENCE EDUCATION STANDARDS		TASK NUMBER BY GRADE		
Topic Area	**Develop Understanding Of:**	**Grades K-2** (Pg. 17)	**Grades 3-6** (Pg. 18)	**Grades 7-12** (Pg. 19)
	Understandings about scientific inquiry	Tasks 5 & 6	Tasks 1-3 & 5-8	Tasks 1-3
	Abilities necessary to do scientific inquiry	Task 5	Tasks 1-3 & 5-8	Tasks 1-3
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	Nature of scientific knowledge			Tasks 1-3

THE GREAT MIGRATIONS

NATIONAL SCIENCE EDUCATION STANDARDS		TASK NUMBER BY GRADE		
Topic Area	**Develop Understanding Of:**	**Grades K-2** (Pg. 26)	**Grades 3-6** (Pg. 26)	**Grades 7-12** (Pg. 27)
	Understandings about scientific inquiry	Tasks 2 & 3	Tasks 1-3	Tasks 1-4
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	Diversity and adaptations of organisms		Tasks 1-4	
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	Matter, energy, and organization in living systems			Tasks 1-4
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	Changes in earth and sky	Tasks 1-3		
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	Risks and benefits		Task 3	
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ADAPTATION AND HABITAT

NATIONAL SCIENCE EDUCATION STANDARDS		TASK NUMBER BY GRADE		
Topic Area	**Develop Understanding Of:**	**Grades K-2** (Pg.35)	**Grades 3-6** (Pg.36)	**Grades 7-12** (Pg.37)
	Understandings about scientific inquiry	Tasks 1-3	Tasks 1-3 & 7-8	Tasks 1 & 2
	Abilities necessary to do scientific inquiry	Tasks 1-3	Tasks 1-3 & 7-8	Tasks 1 & 2
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	Structure and function in living systems		Tasks 1-5 & 7-8	
	Regulation and behavior		Tasks 1-5 & 7-8	
	Populations and ecosystems		Tasks 1-7	
	Diversity and adaptations of organisms		Tasks 1-8	
	Interdependence of organisms			Tasks 1 & 2
	Matter, energy, and organization in living systems			Tasks 1 & 2
	Behavior of organisms			Tasks 1 & 2
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	Environmental quality			Tasks 1 & 2
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PREDATOR AND PREY

NATIONAL SCIENCE EDUCATION STANDARDS		TASK NUMBER BY GRADE		
Topic Area	**Develop Understanding Of:**	**Grades K-2** (Pg.44)	**Grades 3-6** (Pg.44)	**Grades 7-12** (Pg.45)
	Understandings about scientific inquiry	Tasks 1 & 2	Tasks 1 & 3	Task 3 & 5-6
	Abilities necessary to do scientific inquiry	Task 2	Task 1	Task 3 & 5-6
	Characteristics of organisms	Tasks 1 & 2		
	Organisms and environments	Task 2		
	Structure and function in living systems		Tasks 1-4	
	Regulation and behavior		Tasks 1-4	
	Populations and ecosystems		Tasks 1-4	
	Diversity and adaptations of organisms		Task 3	
	Interdependence of organisms			Tasks 1-6
	Matter, energy, and organization in living systems			Tasks 1-6
	Behavior of organisms			Tasks 1-6
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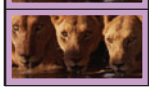
	Environmental quality			Task 6

LIFE CYCLES

NATIONAL SCIENCE EDUCATION STANDARDS		TASK NUMBER BY GRADE		
Topic Area	**Develop Understanding Of:**	**Grades K-2** (Pg. 53)	**Grades 3-6** (Pg. 54)	**Grades 7-12** (Pg. 55)
	Understandings about scientific inquiry	Tasks 2-3 & 6-7	Tasks 2-5	Task 1 & 3-4
	Abilities necessary to do scientific inquiry	Tasks 2-3 & 6-7	Tasks 2-5	Task 1 & 3-4
	Characteristics of organisms	Tasks 1-7		
	Life cycles of organisms	Tasks 2-3 & 5-7		
	Organisms and environments	Tasks 1-5		
	Structure and function in living systems		Tasks 1-6	
	Reproduction and heredity		Tasks 1-6	
	Regulation and behavior		Tasks 1-5	
	Populations and ecosystems		Task 2	
	Diversity and adaptations of organisms		Task 1	
	Biological evolution			Task 1
	Interdependence of organisms			Tasks 1-4
	Behavior of organisms			Tasks 1-4
	Natural and human-induced hazards			Tasks 1-4
	Environmental quality			Tasks 3 & 4

The Earth and the Sun

IN THE FILM

The relationship between the Earth and the sun is at the heart of **earth**. The film tells a global story as it travels north to south showing how the energy of the sun stimulates and sustains all life on the planet. This journey across the Earth's surface witnesses the flow of the sun's energy in the rhythm of the changing seasons; in vast migrations and explosions of new life. It shows how finely balanced the relationship is between Earth and its life-giving star, and how urgent the need to ensure this balance is maintained for the sake of all life on the lucky planet.

SOLAR ENERGY

The sun is the powerhouse that feeds life on Earth. However, the concentration of solar energy that reaches the planet's surface varies from north to south across the hemispheres, and along the same latitude at different times of the year, as the Earth travels its yearlong orbit of the sun.

Due to Earth's spherical shape, the sun's rays strike the planet at a more oblique angle in the latitudes nearer to the north and south poles. In these areas the sun's energy must pass through more of the Earth's atmosphere and spread out over a greater surface area. This means they receive less sunlight, and therefore less energy, than latitudes nearer to the Equator.

ATMOSPHERE FACTS:

- Earth's atmosphere is made up of gases in varying quantities: nitrogen, oxygen, carbon dioxide, methane, nitrous oxide, ozone, water vapor, halocarbons and inert gases
- the "greenhouse" gases: carbon dioxide, methane, nitrous oxide, ozone, water vapor and halocarbons make up only 1% of the atmosphere but they regulate Earth's temperature
- greenhouse gases prevent the energy radiating from the planet's sun-heated surface from escaping into space
- without the greenhouse gases Earth would be on average 86°F (30°C) cooler
- human activity has increased and continues to increase the concentration of greenhouse gases in the atmosphere
- burning wood, oil, coal and gas increases carbon dioxide; deforestation has reduced the number of trees taking carbon dioxide out of the atmosphere
- the consequence of this is global warming

In the tropics, the regions to the north and south of the Equator, the same amount of energy from the sun passes through less of the atmosphere and strikes the Earth's surface at a more direct angle than it does further north and south. As a result, the Earth's surface here receives the energy of the sun in a more concentrated way.

In other words, the same amount of energy hitting the Earth at latitudes closer to the poles is first more dispersed in the atmosphere and then spread more widely over the Earth's surface than it is near to the Equator.

THE TILTED PLANET

A fluke of nature gives the planet its character and dictates the rhythm of life for all the living organisms that populate it: the Earth's tilt. The Earth rotates at an angle of 23.5 degrees from the vertical. Around five billion years ago a huge asteroid crashed into Earth tilting it at an angle of exactly 23.5 degrees to the sun.

Without its tilt, the Earth would be a very different planet. While there would still be climatic variation north to south caused by the varying concentration of solar energy reaching the planet's surface, there would be no seasons and no variation in the hours of daylight and darkness during the year.

THE CHANGING SEASONS

Due to the tilt, latitudes closer to the poles experience dramatic seasonal change. During that arc of the Earth's orbit when the north pole points towards the sun, the northern hemisphere receives more energy from it than the southern, creating summer in the north and winter in the south. During the arc of the orbit when the south pole points to the sun, this position is reversed. Between these two extremes come the transition seasons of autumn and spring. The explosion of new life in spring, the fruits of summer, the falling leaves of autumn and the dormant world of winter are all part of living organisms' response to the increasing and decreasing energy from the sun reaching the Earth's surface. This seasonal change is felt far less dramatically in equatorial regions because there the Earth's tilt has far less effect. There the year divides only into wet seasons and dry seasons.

THE SUN AND THE FORESTS

FOREST FACTS…

- forests are rich, biodiverse ecosystems. They contain animals, trees, shrubs, flowers, ferns, mosses, lichens, fungi and microscopic soil organisms
- forests produce large quantities of oxygen and absorb large quantities of carbon dioxide
- forests regulate the Earth's atmosphere

The forests featured in **earth** vividly demonstrate how the planet's living organisms reflect the variation in solar energy reaching the surface at different latitudes and at different times in the year.

66° TO 50° NORTH: TAIGA FACTS…

- the Taiga is one of Earth's major terrestrial biomes. It is also called the Boreal Forest after Boreas, Greek God of the North Wind
- winter lasts for eight months of the year
- the short summer has 24 hours of daylight
- the average temperature is below freezing for six months of the year
- one-third of all the trees on Earth grow in the Taiga
- the forest supports little animal life

The Taiga is the most northerly of Earth's forests. The majority of the trees in the Taiga are conifers. Conifers are evergreen. Keeping their needles throughout the year means that as soon as the sun returns they're ready to begin photosynthesis, and they don't waste energy growing new leaves. The dark coloring of their leaves helps with both photosynthesis and absorption of heat. Pines, firs and spruces also adapt to survive at this latitude. Their leaves are thin, dark green needles, and they contain little sap so they don't freeze.

PHOTOSYNTHESIS FACTS…

- trees and plants absorb energy from the sun
- trees and plants use this to convert carbon dioxide from the air and water from the soil into food sugars
- trees and plants release oxygen into the air during photosynthesis. The needles thick waxy coat helps them to retain the water. These evergreen trees are always at risk of their branches being damaged by a build up of heavy snowfall, but their shape helps to minimize the risk.

MID-LATITUDES: TEMPERATE DECIDUOUS FOREST FACTS…

- the temperate deciduous forest is one of Earth's major terrestrial biomes
- deciduous means that the leaves "fall"
- deciduous forests are found mainly in the US, Canada, Europe, Russia, China and Japan
- the vegetation can be divided into 5 layers from the bottom up: lichens and mosses, broad-leaved plants, shrubs, small trees and saplings, tall trees up to 100 ft (30 meters)
- average temperature 50°F (10°C)
- average rainfall 30-60 in (75-150 cm)
- these forests are found in the northern hemisphere to the south of the Taiga and in the southern hemisphere

The trees of the deciduous forest look quite different than the Taiga's conifers. They spread outward rather than upward as they grow to have a more rounded shape. They have flat, broad leaves that catch a lot of sunlight. Unlike the conifers of the Taiga, these trees change with the seasons.

AUTUMN AND WINTER

As the period of daylight shortens and the temperature begins to fall during autumn, the chlorophyll in the leaves of a deciduous tree starts to break down revealing shades of orange, yellow and red. This process causes the magnificent display of color in deciduous forests during autumn. The trees lose their leaves in order to protect themselves from the invasion of bacteria and fungi that they would be susceptible to if they froze. Unlike the conifers of the Taiga, they can afford to lose their leaves because they have a long growing season. The leaves gather on the forest floor and form a "litter layer" which gradually decomposes and feeds the soil.

SPRING AND SUMMER

As the days lengthen in spring and the trees get more energy from the sun, they begin to grow their leaves again and to photosynthesize. Summer is their busy time. With their broad leaves the trees capture the sun's energy and convert it into food. Some of this food is then used for growth, and some is stored in the roots for the following spring.

PLANTS AND ANIMALS

Deciduous forests provide a wide variety of food and habitats, so they are home to a wide variety of animals including birds, insects, squirrels, foxes, small deer and bears. The plentiful, thin leaves of a deciduous tree are a good source of food, as are the decaying leaves on the forest floor and the nuts and seeds the trees produce. The feeding behavior and activity of the animals that live in a deciduous forest change as the forest changes. Animals that don't hibernate store food they will need in the winter when the vegetation of the forest is asleep.

TROPIC OF CANCER TO TROPIC OF CAPRICORN: TROPICAL RAINFOREST FACTS…

- the tropical rainforest is one of the Earth's major biomes. Rainforests are the most productive, diverse and dynamic of the land biomes
- tropical rainforests cover less than 3% of the planet's surface but are home to more than 50% of the world's animal species
- one in five of all the birds on Earth live in the Amazon rainforest
- approximately 80% of all insect species live in tropical rainforests
- tropical rainforests receive 12 hours of sunlight all year round
- average temperature around 80°F (25°C); more than 80 in (200 cm) of rainfall a year; average humidity around 80%
- environmental factors combine to create a climate that promotes plant growth year round
- plants of the rainforest generate much of Earth's oxygen
- tropical rainforests can be divided into layers from the ground up: the forest floor, the shrub layer, the understory, the canopy and the overstory

Tropical rainforests are not subject to the same fluctuations of the sun's energy experienced during the year by the temperate deciduous and the boreal forests further north and south. Tropical rainforests grow all year-round. Being sunlit for twelve hours, every day, 365 days a year, the plants of the rainforest can photosynthesize throughout the year and provide a constant and abundant food supply for the rainforest food chains. This stable food supply, combined with stable year round temperature and abundant rainfall, has made the tropical rainforests the most biodiverse habitats on the planet.

BIODIVERSITY

The biodiversity of the tropical rainforests is breathtaking. To list the species would be a life's work; tropical rainforests are home to half of all Earth's species. Just 2.5 acres of rainforest (1 hectare) can contain 250 species of tree and 1 sq mile (2.5 sq km) can contain more than 50,000 insect species. A single bush in the Amazon rainforest can house more species of ants than are found in the entire British Isles, and a single 30-acre plot in the Peruvian rainforest contains the same number of frog species as the entire United States of America. One fig tree can feed 30 different species of birds and 5 species of monkeys.

THE RAINFOREST LAYERS

The plant growth of a tropical rainforest divides into zones. In the top layer, the overstory or upper canopy, tall trees break through the canopy layer and into the sunlight. These widely spaced trees can be over 130 ft (40 meters) in height: they rise above mist and clouds. The canopy layer below them is formed by closely spaced trees of around 65-130 ft in height (20-40 meters). These trees form an umbrella over the forest, a dense ceiling of leaves and branches. Beneath the canopy is the understory. This is the collective name for multiple leaf and branch levels. The understory is more open than the canopy but darker. It contains young trees and plants that can tolerate a lower light level. The lowest part of the understory is the shrub layer, which is only 5-20 ft (1.5-6 m) above the forest floor and contains shrubs and saplings. Finally, there is the forest floor. This is covered in a thin layer of decomposing leaves, seeds, fruits and branches.

The different layers of the rainforest are home to different species of plant and animal life. The trees teem with life: it's estimated that 70-90% of life in the rainforest is found in the trees. The flowering and fruiting trees of the canopy attract a spectacular range of species.

RAINFOREST ADAPTATIONS

The plants of a tropical rainforest are equipped with numerous adaptations to suit the conditions. Leaves often have drip tips and grooves that enable them to shed water and prevent fungal and bacterial growth from developing. Plants in the understory have large leaves to help them capture as much sunlight as possible while trees in the overstory have smaller leaves which reduce water loss. Roots are also adapted to the rainforest environment. The pattern of root growth helps trees stay upright in moist shallow soil: buttress and prop roots spread out above ground to give trees more support than their shallow root systems provide. Plants like lianas, a type of vine, have their roots on the ground but climb up trees high into the canopy to reach sunlight; others like orchids live on the surface of trees in the canopy where sunlight reaches.

Animals are equally adapted. Prehensile tails, loud vocalizations, vivid coloration and pattern and a fruit diet suit animals for survival in the rainforest environment.

THE SUN AND THE WATER CYCLE

WATER CYCLE FACTS …

- water represents only 0.2% of the weight of the planet
- 22% of solar radiation reaching the planet's surface heats liquid water turning it to water vapor
- as it cools in the atmosphere water vapor collects as clouds
- water returns to the surface of the Earth as rain, sleet, hail and snow
- each year 9,500 cubic miles (40,000 cubic km) of water evaporate from the oceans and fall on land

earth shows on a spectacular scale the planet's water cycle in operation, from massive clouds rising above the ocean to the snows of the Himalayas and the cascading giant waterfalls of the planet's great rivers.

THE CYCLE

The water cycle is the circular journey that water makes from the Earth's surface into its atmosphere and back. For the most part, the sun is the engine that keeps the water cycle turning; only a small amount of water vapor is transferred into the atmosphere by the leaves of plants.

The sun heats the water in rivers, lakes, streams and oceans until it changes state, evaporating and becoming water vapor. As water vapor rises into the atmosphere it cools and condenses into tiny droplets forming clouds. These clouds of water vapor move with the air currents in the atmosphere across the seas and the land. As clouds meet, cool air and the droplets of water vapor combine into larger, heavier droplets that fall back to the Earth as rain or, at colder temperatures, sleet or snow. **earth** shows how the moist air blowing from the Indian Ocean cools as it rises over the Himalayas and drops moisture as snow.

Some of the water returning to the Earth's surface soaks into the ground, some of it becomes trapped between layers of rock and is known as groundwater. Most of it flows downhill as runoff, forming streams, lakes, and rivers, before finally returning to the oceans. Rivers can carry rainfall and melted snow immense distances.

Water that falls as snow is delayed in its return to the ocean because it stays on the ground until the heat energy from the sun melts it. Snow that falls on mountain peaks stays there for a long time because the temperature at the top of a mountain is so low. There it can turn into ice and form glaciers. Hundreds of years could pass before the water that falls as snow on mountains melts and begins its journey back to the oceans.

THE OKAVANGO DELTA

WATER IN A DRY SEASON: OKAVANGO FACTS…

- the Okavango delta in Botswana is an inland wetland
- it is one of the largest wetlands in the world
- the flooding of the Okavango river created and replenishes the delta floodplain
- to reach the delta, the waters travel more than 370 miles (600 km) from their source
- during the annual flooding of the Okavango river the area covered by water extends beyond permanent swamp land and increases from 2 to 2.3 – 4.6 thousand square miles (5 to 6 –12 thousand square kilometers)

earth shows the remarkable transformation that water brings about on the planet's surface by focusing on one river and its delta. The delta of the Okavango supports a vast diversity of wildlife as a consequence of a lucky natural phenomenon. The river Okavango rises in the Angolan Highlands and flows south into Botswana. The summer wet season in Botswana and Angola is between November and March when rainfall occurs. However, the peak of the Okavango's floodwaters does not reach the delta until August which is during the local dry season. This is because of the river's gradient. It's so shallow as it travels out of the Angolan Highlands that there's a long delay in the floodwaters arriving at the delta. This floodwater makes the delta a life-saving source of water for millions of animals during the region's long dry season.

THE DESERT TREK OF THE KALAHARI ELEPHANTS

One species that would not survive without the Okavango's flood are the African elephants that live in the Kalahari Desert. These savannah elephants have learned to live in the desert despite its extremely dry climate. Their lifestyle differs from savannah elephants in that they travel vast distances searching for food and water. At times they may go days without eating or drinking.

KALAHARI ELEPHANT FACTS …

- these elephants can travel up to 45 miles (70 km) a day
- their home range can be as big as 6,000 sq miles (15,000 sq km)
- when they find water they can drink as much as 26 gallons (100 liters) at one sitting and 52 gallons (200 liters) in a day
- they can eat 300 lbs of vegetation in a day (140 kg)
- they live in much smaller herds than other savannah elephants
- they socialize and play less as they are occupied with the search for food and water and the need to conserve energy

During the height of summer, elephants migrate to the wetter parts of their habitat to find enough food and water to survive. The elephants filmed in **earth** are crossing the Kalahari in southern Africa during the dry season.

DESERT FACTS …

- deserts are one of the Earth's major terrestrial biomes
- they cover one-third of the Earth's land surface
- deserts are the hottest places on Earth; a temperature of 136.4°F (58°C) has been recorded in the shade at Azizia in Libya
- less than 20 percent of the world's desert areas are sandy
- sub-tropical deserts like the Sahara are "hot" deserts: they have high temperatures all year
- high altitude deserts or continental deserts like the central Asian deserts are "cold" deserts: they have cold winters

The lack of water propels the desert elephants on a desperate trek in which they cover hundreds of miles searching for food and water. They head for a place where they know they will find these: the Okavango delta. The guardian of this knowledge is the matriarch head of the herd. Over many years she has built up an internal map of where water is located. She can lead the herd to sources she has not visited for 20 years.

The journey across the Kalahari to the Okavango delta is grueling for the elephants. They march for weeks through intense heat and dust storms, sharing water holes with the desert lions that threaten both calves and weaker elephants. Like the elephants, the lions can tolerate the extremes of the desert environment. Both can go for two to three months without drinking water. After the elephants trek across the desert, they finally reach their destination: a lush green, flooded landscape that could not contrast more with the desert. **earth** shows them taking full advantage of the waters as they drink deeply, swim and play.

THE EARTH AND THE SUN: ACTIVITIES

Many children find it very difficult to grasp the relationship in space between the sun and the Earth. They often go through phases of becoming completely confused.These activities are designed to encourage children to begin thinking about this difficult topic.

GRADES K-2: EARTH AND SUN

Learning objective

- to understand the changing relationship between the Earth and the sun

Tasks

1. To understand the relationship between the Earth and the sun it is necessary first to understand that the Earth is spherical. Explore a globe, rotating it and finding different places on it.
2. It is key also to understand that there are seasons. Talk about the four seasons, or two seasons, whichever is appropriate. What do children know about each of the seasons? Collect their knowledge in their own 'Book of the Seasons'. For other seasons activities see The Great Migrations section.
3. Do children understand that one cycle of the seasons takes a year to complete? Do they understand what a year is? Investigate a calendar for several years. Can children find the day of their birthday? Can they find it the following year?
4. Do children understand that the seasonal cycle continues; that there is spring, summer, autumn and winter (or alternatively wet and dry) every year? Do they remember things they did in other seasons? Last winter? Last summer? Last wet season?
5. Play with shadows. Find a clear patch where children can stand in the morning on a sunny day and outline each other's shadows. Repeat the process at midday and in late afternoon. What has happened to the direction and shape of the shadow? Why do children think this is? It is sufficient for children at this age to notice that the sun is in a different position in the sky.
6. Talk about other places in the world children have visited or lived in. Do they have photographs of them? Find these places on a globe. What can children who have been there tell others about things like the weather or the plants and animals in these places? Make a book of 'Places on Earth We Know.'
7. Become email pals with an individual or a class in the opposite hemisphere. Exchange monthly emails about what is happening in the natural world in each town/village/city.

GRADES 3-6:
EARTH AND SUN EXPERIMENTS

Learning objective

- to investigate the varying relationship between the Earth's surface and the sun

Tasks

1. Make a simple sundial by putting a stick in the ground. Check it every hour on a sunny day and record the changes. What do children conclude from this? Do they understand that it is the Earth that is turning, not the sun moving?
2. Experiment with a rotating globe and a strong light source. In a darkened room place the light source so that it illuminates one side of the globe. Children can take turns rotating the globe and watching the effect. Place a brightly colored sticker on the globe where the children live. One child can be responsible for watching for when it disappears and another for its return. What do children think this tells them?
3. If children find this difficult to grasp using a globe, play a game in which children themselves rotate so that they are in turn facing to, or away from, a light source. What do they notice?
4. Talk about summer and winter. What do children notice about the hours of daylight and darkness? Is it light or dark when they get up or go to bed?
5. Track the shadows created in the environment during the year. Choose a tree, or a building, or anything that creates a well-defined shadow. On the first sunny day of each month observe where the apex of the shadow is at midday. Either make a permanent mark (if that is possible) or note down a landmark it reaches. Watch the changes month to month. Does the shadow shorten and lengthen? Does it stay the same?
6. On the first day of each month check the time of sunrise and sunset locally. Choose one or two other locations on the planet either much further south or much further north. Use the Internet to check sunrise and sunset times there. Record the information for all the locations in a chart. What do children notice?
7. Record the temperature outside at the same time every morning. Plot the results on a graph. What do children notice?
8. Use large and small spheres to show how the Earth orbits the sun. The sphere representing the Earth must rotate, and must be tilted as the Earth is.

GRADES 7-12:
THE EARTH'S TEMPERATURE

Learning objectives:

- to understand that the amount of energy from the sun reaching the Earth's surface varies with latitude and season
- to understand the impact of greenhouse gases on the retention of the sun's energy and the consequential impact on the Earth's habitats

Tasks

1. In a darkened room, position a rotating globe so that the northern hemisphere is angled away from a strong light source representing the sun. Students can experiment with rotating the globe to observe where the light falls. Choose a point within the Arctic Circle, mark it and track its passage from dark into light. Choose a place in Antarctica and on the Equator and repeat the process. Record the findings then reverse the experiment by positioning the globe so the southern hemisphere is angled away. Compare the results.

2. Experiment with a powerful flash light and the globe. Make sure students understand that the flash light does not represent the sun, but represents a quantity of the sun's energy hitting the Earth's surface. First shine the light on the globe at the Equator. What do students notice about the beam on the surface? Then, keeping the light in exactly the same orientation and exactly the same distance from the globe, move it up or down so that it shines on the globe at a northerly or southerly latitude. What do students notice about the beam? What do they think this tells them about the energy from the light, and by analogy the energy from the sun?

3. Discuss the relationship between the increase in greenhouse gases and global warming. Design a presentation to explain global warming to an audience who do not understand it. It has to be clear and simply expressed or they will not be able to absorb it.

4. Design a poster to impress on humans what their actions are doing to the planet (see the section on the Polar bear's habitat, the Arctic, in Adaptation and Habitat). It should be vivid, memorable and feature a catchy slogan.

5. Design a leaflet to send to people's homes telling them what they can personally do to limit their impact on the Earth's atmosphere.