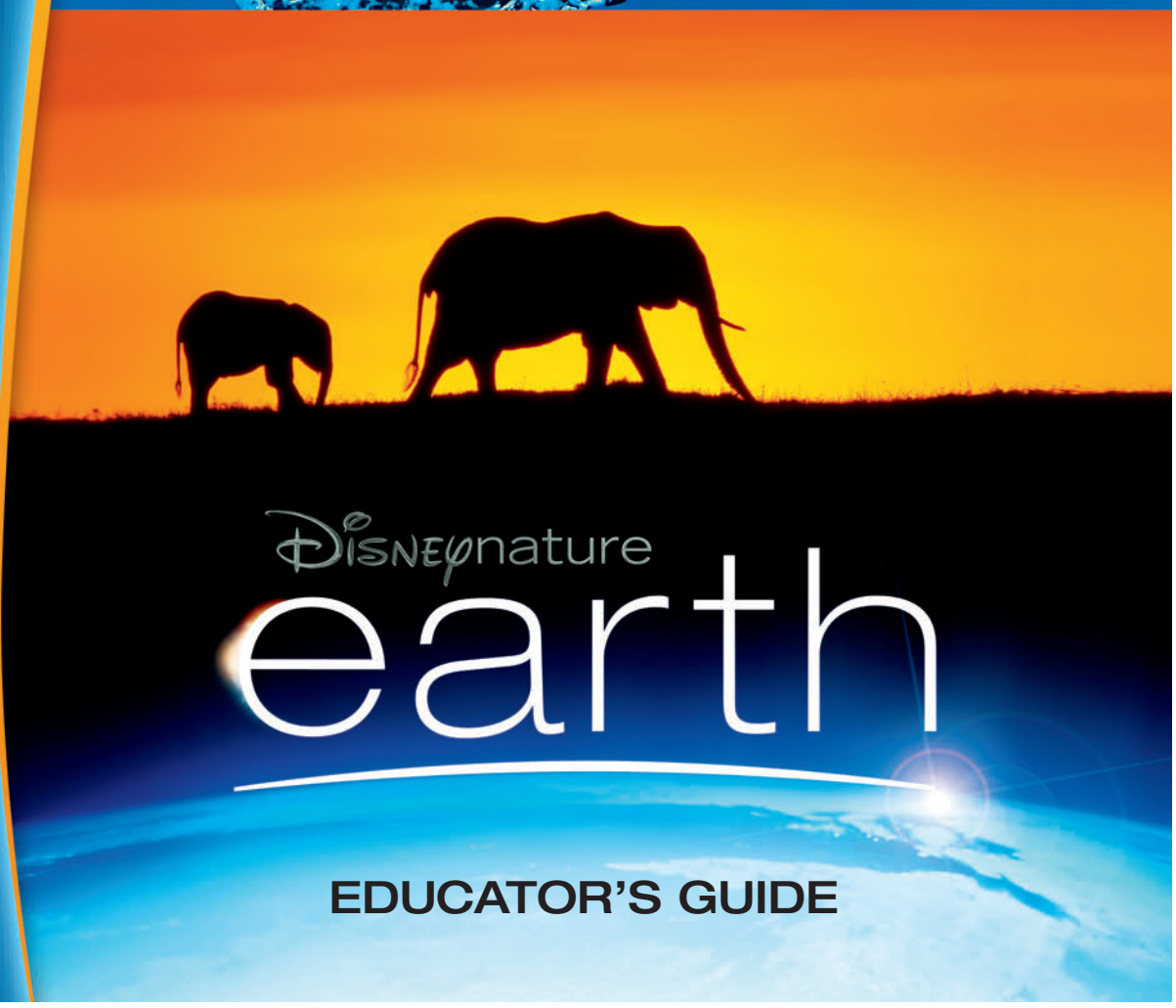

Disneynature

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		
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	Understandings about scientific inquiry	Tasks 5 & 6	Tasks 1-3 & 5-8	Tasks 1-3
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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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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
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	Regulation and behavior		Tasks 1-5 & 7-8	
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	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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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	
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	Interdependence of organisms			Tasks 1-6
	Matter, energy, and organization in living systems			Tasks 1-6
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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
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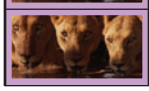
	Life cycles of organisms	Tasks 2-3 & 5-7		
	Organisms and environments	Tasks 1-5		
	Structure and function in living systems		Tasks 1-6	
	Reproduction and heredity		Tasks 1-6	
	Regulation and behavior		Tasks 1-5	
	Populations and ecosystems		Task 2	
	Diversity and adaptations of organisms		Task 1	
	Biological 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.

The Great Migrations

IN THE FILM

The central theme of **earth** is the effect the sun's energy has on life on the planet's surface, and the seasonal change that results from its tilted orbit. As the sun's energy intensifies in the northern hemisphere's spring, it releases the tundra from its blanket of snow resulting in massive herds of caribou migrating north to take advantage of the burgeoning vegetation. As the chill of autumn comes to the Tibetan steppe, flocks of Demoiselle cranes battle the winds of the Himalayas in a find winter shelter in India.

As the warming sun comes to the Antarctic, Humpback whales set off from the tropics for their feeding grounds there. **earth** sweeps across the surface of the planet to witness these great migrations. The journeys are fraught with danger. A portion of the migrating animals will not survive, but by making the journey, they ensure the survival of their species as a whole.

MIGRATION FACTS…

- most migrations are triggered by environmental changes: food shortage, changes in temperature, changes in length of daylight
- only the tropics don't experience these changes
- environmental changes work with a genetically inherited sense of impending change to impel animals to migrate
- billions of animals migrate, from the smallest insect to the Humpback whale
- a migration journey may be just a few hundred feet or thousands of miles over land, or through air and sea
- most animals navigate during their migration using the sun as their guide
- elephants use the sun in combination with land cues
- Humpback whales are thought to use magnetite in their brains to detect changes in the Earth's magnetic field
- many experienced migratory birds use landmarks to pilot their way

THE CARIBOU TRAIL: THE LONGEST OVERLAND MIGRATION

CARIBOU FACTS…

- caribou are found across Northern Europe and Asia from Scandinavia to Siberia as well as in Alaska, Canada and Greenland
- they eat grass and plants in summer and lichen in winter
- a female caribou gives birth to one or two calves after about an eight-month gestation
- male and female caribou both have antlers
- reindeer are caribou

The caribou undertake the world's longest land migration: some 2,000 miles. As spring arrives in the northern hemisphere and the sun returns to the Arctic, the thaw moves north across the tundra and more than three million caribou follow. The caribou's migration is matched to the pattern and speed of the melt. They travel in vast herds searching for fresh pasture and a place to calve, taking advantage of the new plant growth and the nutrition this will offer their newborns.

ARCTIC TUNDRA FACTS …

- the tundra is the most northerly of Earth's major terrestrial biomes, circling the globe to the south of the North Pole
- it has very cold winters; short, cool summers and little rainfall
- winter temperatures can fall to -60°F (-51°C)
- summer temperatures can rise to between 37°F (2.7°C) and 50°F (12.2°C)
- the soil of the tundra is frequently frozen
- a meter below the surface is permanent ice: permafrost
- no trees grow in the tundra

LONG RANGE TRAVELERS

Caribou are built for their epic journey. Their hooves are large and concave. These act like snowshoes, holding the caribou up both on winter snow and on the soggy summer tundra. In water, they operate as enormous paddles, propelling the animal forward. Caribou can swim across fast-flowing rivers and large lakes with ease. They even have the added benefit of a kind of flotation jacket. The hollow hairs of their coat trap air and help to keep them afloat. Nevertheless, they take care when crossing rivers, either scouting for a safe crossing point or waiting for favorable conditions in which to cross.

DANGEROUS ENCOUNTERS

Throughout their journey the caribou herds have to keep constantly on the move. Calves born on the migration must be on their feet and running the day they emerge. This is a perilous time for the caribou. Their constant companions are wolves. They shadow the herds as they migrate. The wolves' hunting strategy is to run at the caribou, creating panic and chaos in which they can separate young calves from their mothers. Once a wolf is chasing it, the calf has a fifty-fifty chance of survival. If it can stay on its feet, it is capable of outrunning a wolf. A caribou can run at 50 miles (80 kilometers) per hour. If it makes one mistake, the wolf will be on the calf.

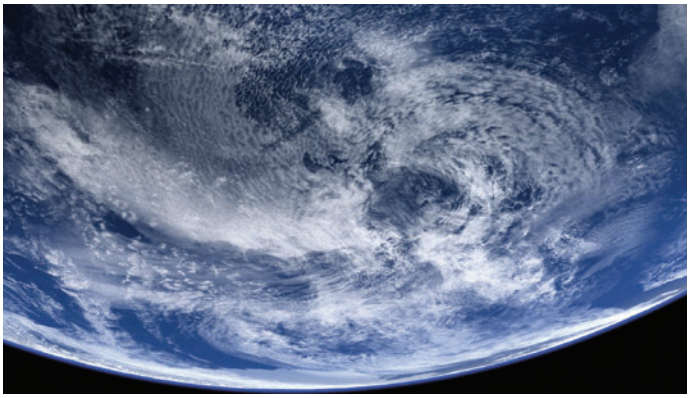
GREY WOLF FACTS…

- grey wolves travel greater distances than any other land mammal except the caribou
- the wolves may hunt alone, but usually they hunt in packs of 3 to 30 members
- the size of a pack's territory in Alaska and Canada is about 600 square miles (1,500 sq km) but it can be as large as 1,000 square miles (2,500 sq km)
- grey wolves are good swimmers and will pursue their prey into water

At the other end of the scale, another danger for the caribou are mosquitoes. These are widespread in the caribou's summer range and a major irritant to them. If a caribou spends too much time and energy running away from mosquitoes, it will not eat enough and put on sufficient weight in the summer to see it through the following winter.

SUMMER RANGE AND WINTER RANGE

In their summer range the caribou have access to a rich supply of food, which means that both adults and calves can gain weight and build their strength in order to survive the following winter. This is crucially important for the survival of the herd. They head south again to their winter range often after the first severe autumn storm. Here the weather is less harsh and the snow cover less impenetrable, which means they will still be able to find food. They often migrate to a different area of their winter range in successive years so they avoid stripping an area of available food.



FROM THE TROPICS TO THE POLAR SEAS: THE 4,000 MILE JOURNEY OF THE HUMPBACK WHALE

HUMPBACK FACTS …

- Humpbacks are among the largest mammals on Earth. They can grow up to around 48 ft (15 meters) long and can weigh more than 33 tons
- they feed on krill and small fish, each whale eating up to 1.1–1.65 tons of food a day
- they are found in all the oceans of the world, apart from the Mediterranean and the extreme Arctic
- they mature between 6 and 8 years of age and a female may give birth once every 2 to 3 years – the gestation period lasts about 12 months
- a Humpback whale calf is between 10-15 feet (4–5 meters) long when it's born and weighs up to 1.1 ton
- they can live up to 70 years of age, the average being about 50
- all Humpbacks sing
- the whale song varies geographically and is more often heard when they are in tropical waters

IN TROPICAL WATERS

earth follows the migration of the Southern hemisphere population of Humpbacks. They spend their winter, from May through late November, in the warm waters of the tropics: waters that are suitable for breeding and calving. During these winter months, a Humpback calf develops rapidly by suckling frequently on its mother and consuming her high-energy milk: it has a 45-60% fat content. The calf will need all its strength to endure the epic 4,000-mile journey it will make with its mother to the waters off the Antarctic peninsula.

The calf's mother doesn't feed at all in these months; she survives on her blubber. Tropical waters are comparatively poor in nutrients. They support a diversity of life, but not the large populations of krill and small fish that a whale needs to feed on. By the time November comes the whales must migrate in order to feed on the vast quantities of food they will find in the Antarctic.

THE JOURNEY SOUTH

Mothers and calves tend to be the last whales to begin their migration, delaying until the calf is as strong as possible. The journey south is long, arduous and potentially perilous for a young whale and a weak mother whale that hasn't eaten for four months. On their journey they will cross half the globe, from the tropics all the way to the edge of Antarctica. The Humpback's migration is the longest migration undertaken by any mammal on the planet. When they're migrating, Humpbacks travel at an average speed of about 5 mph (8 km/hr).

As they leave the calm of the tropical seas behind them the waters become colder and rougher. It's essential that the mother and calf stay close to each other; young Humpback calves making their first migratory journey to Antarctica are particularly vulnerable to attacks by sharks and Killer whales. To avoid getting separated and losing track of each other, mother and calf keep in contact by slapping their fins on the surface of the water. They can hear these sound signals above the roar of the ocean.

The journey for the calf is massively energy consuming. It conserves energy by swimming in its mother's slipstream. It positions itself just behind the mother's widest diameter, just underneath and to the side of her dorsal fin. By doing this, it can keep pace with its mother using only 75% of the effort it would use otherwise. Nevertheless, even employing this energy-saving strategy, many calves die of exhaustion during the journey.

THE ANTARCTIC SUMMER

The Humpbacks reach their destination in time for the brief, three-month Antarctic summer. At last, after their 4,000-mile journey, the whales can feed.

ANTARCTIC SUMMER FACTS …

- Antarctic waters are rich in nutrients
- the continuous 24 hours of daylight in summer produce an annual bloom of phytoplankton in the Antarctic Ocean
- phytoplankton are the basis for the Antarctic Ocean food chain
- krill, small shrimp-like creatures, feed on the phytoplankton and multiply in vast numbers
- swarms of krill become concentrated in ice-free bays and attract whales

The arrival of the whales in the Antarctic coincides with the melting of the sea ice and the explosion in numbers of swarming krill. Humpbacks sometimes feed on the krill co-operatively using a method called "bubble netting." A group of whales dive perhaps 160 feet (50 meters) below a shoal of krill then slowly return to the surface in a spiral formation, blowing bubbles. These underwater bubbles create a sort of curtain that herds the krill together and forces them towards the surface at the center of the circle. Eventually the whales surface, their mouths wide open as they take in mouthfuls of the mass of krill trapped in the middle of the circle of bubbles.

As the season changes and the sun starts to sink below the horizon again, the whales will make their return journey to the warm water of the tropics.

ABOVE THE ROOF OF THE WORLD: THE MIGRATION OF THE DEMOISELLE CRANES

DEMOISELLE CRANE FACTS…

- Demoiselles are the smallest of the cranes, just 3 ft (90 cm) tall and weighing 4–7 lbs (2–3 kg)
- they have a wing span of 1 ft 6 in (50 cm)
- they live mainly in grassland areas near water but can be found in deserts where water is available
- Demoiselles mate for life and continue their courtship "dance" throughout their lives to maintain their bond
- they usually lay their eggs directly on the ground and their chicks fledge fastest of all cranes at around 55 days
- Demoiselle cranes were given their name by Queen Marie Antoinette, because of their delicate, maiden-like appearance

Demoiselle cranes undertake one of the most challenging migrations in nature. Each year, thousands of them bid to escape the harsh winters of the Tibetan steppe by flying south. They fly in a V-formation at very high altitudes, up to 25,000 feet (7,620 meters), and keep in contact by constantly calling to each other. Their destination is the warmer climates of India, but to get there they have to cross the highest mountain range on Earth: the Himalayas.

HIMALAYA FACTS …

- the planet's 14 highest peaks are in the Himalayas
- the highest is Mount Everest at 29,028 feet (8,848 meters)
- the Himalayan range of mountains stretches across one-tenth of the planet
- the Himalayas prevent the cold, dry winds of the Arctic from reaching the Indian subcontinent and keep South Asia warm
- they force the monsoon winds blowing north from the tropics to drop their rain as they rise over the mountains

As the sun heats the slopes of the mountains, warm air rises from the valleys. The cranes use the uplift of the thermals to gain height as they fly towards the summit of the mountains. If the weather changes, these small, elegant birds can be buffeted so violently by the wind that they would be forced to give up and delay their attempt to surmount the peaks to another day. They would try again when the sun rises. As they attempt their crossing, they have to judge whether or not they have the strength to battle against the freezing winds around the peaks. If they turn back they will face the bitter extremes of winter on the Tibetan steppes. They must go on if they are to reach their winter sanctuary.

THE GREAT MIGRATIONS: ACTIVITIES

GRADES K-2: SEASONS DIARY

Learning objective:

- to understand that the Earth experiences seasonal change

For children of this age to begin to understand the concept of migration they need first to understand that the Earth experiences seasonal change.

Tasks

1. Several sequences in the film show seasonal change. The deciduous forest sequence shows it particularly well, although very young children may have difficulty in understanding that a filming trick is used to show change at an accelerated speed. How many changes can children remember seeing (e.g., leaf growth, blossom, spring flowers, animals and their new offspring, etc.)?
2. Have the children seen changes like these in their own environment? Talk about them and create 'seasons' pictures. Collect these together into a gallery of pictures for a particular season.
3. Talk about how seasonal change affects humans. How does it affect the children? Do they wear different clothes? Does what they eat change? Do their daily activities change (e.g., travelling to school, playing, etc.)?

GRADES 3-6: SEASON WATCHING

Learning objectives:

- to develop skills of scientific observation
- to understand how environmental change impacts on animals

Tasks

1. Become a Season Watcher. This can be done by a class as a group or by an individual. Start a notebook in which to keep observations of the natural world. What do children notice about temperature, trees, plants, local wildlife, weather, hours of daylight? Take photographs and make drawings.
2. Think about how the local environment changes seasonally and the effect this might have on wildlife. Talk about how these changes trigger migration.
3. Think about the conditions in the environments the featured animals in **earth** migrate between. How are they different? How are they the same? Record this information in a chart. What impels the animal to migrate? What does the animal find in its new location (e.g., food, water, security from predators during breeding, more favorable weather conditions)?
4. Plot on a map or globe (real or virtual) the routes of the migrating animals featured in **earth**.

GRADES 7-12: JOURNEYS OF LIFE

Learning objective:

- to understand the importance of migration to a species' survival

The stories in **earth** demonstrate vividly the epic and perilous nature of the migration journeys many animals take. Yet, despite the risks, these annual treks continue, indicating this behavior must be immensely beneficial to the species as a whole.

Tasks

1. Use the stories of migration in **earth** as the starting point for a discussion of the part played by migration in the continuing survival of a species. How does migration benefit each of the species featured? Does it benefit them in the same or in different ways?
2. Study migration in the local area. Birds are a particularly good focus for a migration project because some stay in a locality all year, some visit during a season and some pass through on their way to another destination. Monitor the bird population in an area and make a record of it.
3. Focus on one of **earth**'s migrating animals and research their journey in further detail. How could changes in environmental factors affect these animals? The caribou are a good case in point. As land migrating animals, they have to cope with any obstacle in their way. Roads and pipelines are known to cause problems for caribou, deflecting them from their migratory route. What might be the consequences for the caribou of obstacles placed in their path? What would happen if the caribou were diverted from the rich vegetation of their calving areas? How might the impact of obstacles be limited?
4. Research the navigational devices animals use to pilot their way on their migrations.

Adaptation and Habitat

IN THE FILM

earth reveals a breathtaking vision of the planet's habitats and makes it possible to truly appreciate just how extreme the contrasts are between the environments the planet's animals call home. The Polar bear mother and her cubs emerge from the crisp, white pristine snow of the Arctic into a world of ice cliffs and frozen ocean as far as the eye can see. Thousands of miles south, the Humpback whale gently supports her calf in the still and shallow sunlit waters of the tropics. The African elephant and her calf traverse a desert landscape of parched vegetation and cracking sun-baked earth as they cross the Kalahari, enveloped in billowing clouds of dust. These places on Earth's surface could not be more different, and each of them is inhabited by one of Earth's great mammals.

HABITAT FACTS…

- a habitat is an environment that provides an organism – plant or animal – with the conditions it needs to live
- all living organisms are adapted to the habitat in which they live

THE POLAR BEAR

POLAR BEAR FACTS …

- found throughout the Arctic on ice-covered waters from Canada, to Norway, parts of the USA, Russia and Greenland
- will travel hundreds of miles in search of food
- can smell seals several kilometers away
- can swim 12 miles (20 km) a day
- Latin name “Ursus maritimus” means “sea bear”

Polar bears are perfectly adapted to the frozen Arctic world they inhabit. Their habitat experiences dramatic change during the year. As the Earth travels on its annual orbit, the polar sea ice melts in the heat of the summer sun and freezes again as polar winter comes. The sequences in **earth** show how the Polar bear is completely equipped for survival in both these states.

LIFE IN A COLD CLIMATE

On average, the temperature in the Arctic winter drops to -29°F (-34°C). If a Polar bear is to survive it has to be able to keep warm. The black tip of its nose gives a clue to one of its key adaptations. Beneath the dense yellowish white fur, a Polar bear’s skin is black. This dark color helps it absorb heat from the sun. As well as being adapted to take in heat, it is adapted to keep out cold. Below the skin a Polar bear has a layer of blubber. This layer of fat acts as an insulator, keeping its body temperature and metabolic rate the same even if the outside temperature drops to -29°F (-34°C). The bear’s fur also keeps out the cold. The wool underneath creates an insulating layer that keeps the bear warm when it’s in water. In fact, a Polar bear’s body is so effective at keeping warm that Polar bears are sprinters, not marathon runners! They can only run for short distances because over longer distances they’re in danger of overheating!

HUNTING FOR FOOD

The Polar bear prefers to hunt its main food source, the Ringed seal, on the Arctic sea ice. The bears catch the seals as they emerge through holes in the ice to breed, or when they take to the ice to give birth. Polar bears are well adapted for this hunting style. Their white fur camouflages them very effectively as they lie in wait for their prey. The bear even covers its black nose with its paws to keep this out of sight! When a seal appears the Polar bear can move very quickly. It pounces on the seal using its huge clawed paws. When it eats, a Polar bear can consume a huge quantity of food. This gives it the energy to survive in such a cold climate. It gets all the liquid it needs from its food so it has no need to drink water.

HIBERNATION

Polar bears are adapted to survive a food shortage. Pregnant female Polar bears spend winter in a den. They don't go into true hibernation as they give birth during this time. They do, however, go into a state of lethargy in the den in which their heart rate slows and they sleep soundly but are easily roused. Males and other females go into "walking hibernation." The bear's metabolism alters to a hibernation-like state that conserves energy and enables it to go for days without food. This isn't something the Polar bear does only in winter. It can do it at any time of year if food supplies become scarce. By doing this, it can survive a period of hunger out on the sea ice.

WALKING ON ICE

A Polar bear spends its life patrolling an icy kingdom and its paws are particularly adapted to do this. The soles have indents. These act like suction cups to enable the bear to grip. They work in combination with the large non-retractable claws the bear has, one on each foot. Just like ice picks, these too prevent the bear from slipping.

THE SEA BEAR

During the summer months when the sea-ice melts, large tracts of the Polar bear's frozen world turns to water and it has to get around by swimming, not walking. Its big forelimbs and paws help it swim between islands and ice flows in search of fresh hunting grounds. There are numerous islands in the Arctic. The bears of **earth** were filmed on Kong Karls Land on the Svalbard archipelago north of Norway. Polar bears are strong swimmers. Using their front paws to propel themselves and their rear paws to control their direction, they can swim for long distances and have been spotted 62.14 miles (100 km) offshore from the nearest landfall.

THE AFRICAN ELEPHANT

AFRICAN ELEPHANT FACTS…

- adapted for survival in a range of habitats including desert, swamp, forest, savannah, seashore and mountain
- largest living land mammal – the largest elephant ever recorded was 12 feet (4 meters) at the shoulder and weighed 10 metric tonnes
- they may spend 12-18 hours a day feeding
- an adult elephant needs over 300 lb (140 kg) of food a day
- can consume up to 50 gallons (200 liters) of water a day
- their ears can be 6 ft (200 cm) from top to bottom
- they have a large brain
- hide is over 1 inch (3 cm) thick in places

FOOD AND WATER

An elephant needs a huge quantity of food and water to live. This is why large herds of elephants are found only in food-rich areas like the savannahs of southern Africa. In deserts, where there is little food and water available, each herd contains only a small number of elephants. Elephants often migrate between habitats to feed their enormous appetite. The elephants of the Kalahari Desert in Botswana, seen in **earth**, migrate annually to the swamps of the Okavango to find enough food and water to live. The elephant's large brain helps it to remember the location of areas where food and water are seasonally abundant. Its brain may also enable the elephant to store other information. Hence an elephant is known to "never forget!"

THE MULTI-FUNCTION TRUNK

Feeding is just one function of the elephant's remarkable multipurpose adaptation: its trunk. Elephants eat all sorts of vegetation including grass, tree foliage, bark, and twigs. An elephant manipulates food and brings it to its mouth using its trunk. The trunk has numerous tiny muscles that allow the elephant to grasp branches and twigs. The elephant uses its trunk much as a human uses its hands. It has different techniques to deal with the different food types in its varied habitat: pulling up long grass with the trunk; loosening and kicking short grass into a pile with its forefeet before sweeping it up using the trunk. The African elephant can achieve very fine control with its trunk because it has two projections at the tip that act as the equivalent of two fingers. It also uses the trunk to suck up water and shoot it into its mouth to drink. An elephant doesn't drink straight from its trunk.

TUSKS

Elephants' ivory tusks are actually elongated teeth. They use them to dig out the minerals they need in their diet and to dig waterholes in dry riverbeds. These holes, excavated using the trunk, tusks, and feet, can be several feet deep. It's thought that their location is learned from social interactions.

A SOCIAL ANIMAL

Elephants are social animals. They have a number of adaptations that help them maintain communication. Their sensitive hearing allows them to keep in touch over long distances. They also use their ears as signalling devices, often to warn the herd of approaching danger. The well-developed sense of touch in their trunks is used not just for feeding, but also for social purposes.

LIFE IN A HOT CLIMATE

African elephants are adapted to survive the intense heat of the African sun. The elephant's surface area is small by comparison with its total mass. This makes it difficult to lose excess body heat. Their massive, fan-like, triangular shaped ears act as a cooling system. They are filled with blood vessels. By holding them out in the wind, or flapping them, the elephant can increase the movement of air over its ears and cool the blood running through them, thereby regulating its body temperature. They also use their trunks to cool themselves by sucking up water, or mud and dust when they're bathing (which they like to do and are seen doing enthusiastically in **earth**) and spraying it over their body. This also keeps the elephant's hide in condition. Its thick hide protects it both from attack by insects that might spread disease and from the rough ground and thorny bushes found in the elephant's habitats.

Because of their size and weight, it's not easy for an elephant to go unnoticed! Elastic, spongy cushions on the bottom of its feet help. They act as shock absorbers and help elephants move silently.

THE HUMPBACK WHALE

HUMPBACK FACTS …

- Humpback whales are found throughout the world's oceans
- the Humpback's Latin name is "Megaptera novaeangliae"; megaptera means "huge wings"
- a Humpback's flippers are the largest of any whale, up to one-third the length of its body
- the blubber of a Humpback is the thickest of all whales
- a Humpback whale has approximately 330 pairs of baleen plates instead of teeth hanging from its jaw
- Humpback whales' very small eyes help them withstand the pressure of a deep sea dive

LIFE AT THE TROPICS AND THE POLES

Humpback whales live at the surface of open oceans and in the shallow coastal wards. At different times of year they occupy two distinct and different areas of their habitat: one in the tropics and the other in the waters far south and far north towards the poles. The tropics are their breeding grounds and they spend winter here in the warmth of the tropical seas. The shallow equatorial waters make good nurseries because they are calm and contain few predators. The polar waters are their feeding grounds. When spring comes, the Humpbacks and their calves set off: the northern hemisphere population of whales going north to the Arctic summer, the southern hemisphere whales south to the Antarctic summer.

The Humpback's enormous flippers and fluke-shaped tail power it on this journey. Beneath the whale's skin is a layer of blubber. The Humpback has the thickest blubber of all whales. It enables this warm-blooded mammal to conserve energy and heat when it's in the cold water of the poles. When the whale is wintering in warm tropical waters the layer of blubber thins out as the whale lives off it in the absence of other food.

Summer is feeding time for Humpbacks. The whales don't feed during the months they spend in their winter breeding grounds. Humpbacks are baleen whales. They have huge plates of long hair-like filaments instead of teeth. These baleen plates hang in rows from each side of the upper jaw. They are strong, flexible and made from a similar protein to the human fingernail. They filter vast quantities of water when the whale opens its mouth. Humpback whales have throat grooves that run from chin to navel. These enable the whale's throat to expand and allow large volumes of water and food into the mouth. As the mouth closes, the whale presses down with its tongue forcing all the water out through baleen plates and retaining the krill that are the whale's main food source. The polar seas are filled with billions of these tiny shrimp-like creatures. Thousands of them are filtered from each mouthful of water. During their stay in their summer habitat, the whales feed on them nonstop.

ADAPTATION AND HABITAT: ACTIVITIES

GRADES K-2:
WHO LIVES WHERE YOU LIVE?

Learning objectives:

- to observe that different habitats are populated by different organisms
- to develop skills of observation and recording

Tasks

1. Talk about the featured animals in **earth**. What do children notice about where they live? What is it like where the Polar bear lives? Is it hot or cold? Are there any trees? What other animals live there? What is it like where the whale lives? What is it like where the elephant lives? Draw pictures of the animal in its habitat. Children can find inspiration for these beautiful images in the film.

2. Where did other animals in the film live? What was it like where the lynx lives? And the duck family?

3. Investigate the animals and plants in the local environment. This could be school or home-based project for an individual child or group of children. They can draw a map or plan of the locality and go on a habitat walk to observe the plant and animal life they see. They could focus on a patch of the land around their home, an area of the school grounds, or a space in the local area. They can look at sunny areas, shady areas, damp or dry areas, under stones, in bushes and trees, on open land, and in water. These are habitats of different scales, but at this age this matters less than giving children the opportunity to see that different organisms are living in different conditions. They can record on their plan, using drawings and writing, the plants and animals they see and a description of where they saw them.

GRADES 3-6: ADAPTATION

Learning objectives:

- to understand that a habitat provides an animal or plant with the conditions for life
- to understand that different animals are found in different habitats
- to understand that an organism is adapted to its habitat

Tasks

1. Talk about the different habitats that are featured in **earth**. The film contains spectacular sequences that will give children a real sense of the habitats the film visits. What is the Polar bear's habitat like? What is the whale's habitat like? What is the elephant's habitat like? Make a chart of the features of each habitat including information on temperature, sunlight, water, vegetation and other animal life.

2. Talk about how the main characters featured in **earth** are adapted to their habitat. What features of the Polar bear make it so suited to its Arctic environment? Talk about the whale and the elephant. How are they adapted to their habitat? Make a chart to show how each animal is adapted, or draw the three mammals and annotate drawings to show their adaptations.

3. Talk about the three animals. Could they exchange habitats? Why not?

4. Write a fantasy story in which one of the animals featured in **earth** gets transported to the wrong habitat. What happens to it and how does it get back to where it belongs?

5. Create an imaginary animal and an imaginary habitat for it to live in. What adaptations will it have? How will these adaptations make it suited to the habitat in which it lives? The important things for an animal are to have food, water, and shelter.

6. Make a "Where do I Live?" snap game. Collect pictures of animals and stick them on a card. Create a set of matching cards on which is written a description of an animal's habitat. Two players put down cards until one sees a match between an animal and its habitat.

7. Make a study of two contrasting habitats in the local area. Visit them to take photographs and make notes on the nature of the habitat and the animals and plants living in it. These could be any habitats as long as there is a clear contrast between them. How exactly are the habitats different (water? light? soil? exposure?) Are some plants and animals living in one but not in the other? Are some living in both? Are some plants growing better in one than the other? What can children conclude about the conditions the different plants and animals need for life? Their conclusions could be presented in many ways: as a collage picture, as a computer slide presentation, or even as a video.

8. Try an adaptation experiment by growing the same plant in two different sets of conditions. Plants of the same species often grow to suit their conditions. Bluebells (Hyacinthoides non-scripta), for example, which are featured in **earth**'s deciduous forest sequence, grow taller in the shade than in the sun.

GRADES 7-12: HABITATS AT RISK

Learning objectives:

- to investigate the consequences of environmental change in a habitat

All forms of life, from the tiny plankton in the oceans to the elephants roaming the African savannahs, have an intricate relationship with the habitat in which they live. They are dependent on it for food, water, warmth and shelter. They are adapted to live in it, which means they face huge problems if that habitat changes. A habitat can change for any number of reasons, manmade or natural. Currently, many habitats are feeling the effects of global warming.

Global warming impacts every form of life. African elephants have used mental maps and memory over thousands of generations to find reliable water and food sources during the dry season. Global warming is predicted to effect rainfall, turning more land to desert, causing droughts and the drying up of water sources, and potentially leading elephants to migrate hundreds of miles in search of food and water that are no longer there. The survival of African elephants is already seriously threatened by changes in their habitat caused by human settlement on land they once roamed. The consequences of global warming can only make their plight worse.

Humpback whales could also face an uncertain future. Changing sea temperatures can affect oceans and potentially make any migration by the Humpback whales difficult. The whale's food supply could become unreliable if the supply of krill in the feeding grounds is reduced, or relocated. For the whale, this potential disaster lies in the future. Humpback whale populations are increasing at present. For another star of **earth** the threat is immediate.

THE VANISHING KINGDOM OF THE POLAR BEAR

The animal that is facing the most sudden and disastrous change in its habitat is the Polar bear.

THE POLAR BEAR'S WORLD

Unlike Antarctica, which is a continent in a hemisphere that is mostly water, the Arctic is mostly ocean surrounded by land. Most of the Arctic Ocean is more than 3,000 feet (1,000 meters) deep and continuously covered with ice that varies between 3 feet (one meter) and 30 feet (10 meters) thick. About one third of the Arctic Ocean is shallow. Unlike the deep ocean, this is not ice-covered year round. This sea ice is the key to life in the Arctic. It forms a platform on which animals hunt, breed, give birth and travel.

This is a habitat in constant flux. Due to its high latitude, the Arctic experiences significant seasonal variation. The increase in the sun's energy in spring causes the sea ice to begin to melt. It breaks up into enormous ice floes and by summer is almost gone. In summer, when the northern hemisphere is tilted towards it, the sun remains above the horizon twenty-four hours a day. Hence the Arctic is called at this time of year "the land of the midnight sun." In winter, when the pole is tilted away from the sun, the Arctic experiences a twenty-four-hour night and the sea ice freezes again. In recent years scientific study has shown that this cycle of melting and freezing is changing.

On average, temperatures in the Arctic drop in winter to -29°F (-34°C) but recently unusually warm winter temperatures have been recorded. At the same time changes have been observed in the sea ice. It's melting earlier than it used to: in some areas up to three weeks earlier than it did 30 years ago. In addition to this, the extent of the sea ice is also decreasing.

SEA ICE FACTS …

- between 1979 and 2003 the extent of winter sea ice fell by only 3% per decade
- in the winters of 2004 and 2005 the extent of winter sea ice fell by 6%
- summer sea ice continues to retreat at an average of 10% per decade
- one study has recorded more than a 40% loss in sea ice thickness in the past 25 years

These changes spell disaster for the Polar bear. The bear's life cycle is perfectly attuned to its Arctic world, and it is unprepared for this sudden change. Some studies have already shown a decrease in the weight of adult polar bears from an average of 650 lb (300 kg) in 1980 to 507 lb (230 kg) in 2004. In an area of Hudson Bay, the Polar bear population decreased from 1,200 to 1,000 in the ten years before 2004.

Tasks

1. Using the data on habitat change in the Arctic, in combination with the data on the Polar bear life cycle (see the Life Cycles section of the guide), investigate what the implications of changes in the Arctic are for the Polar bear. Make a chart of the Polar bear's year showing the bear's activity in each month and the Arctic climate and condition of the Arctic ice at that time. Then predict how the changes already underway will impact the Polar bear. What will happen if temperatures continue to rise and the sea ice reduces further in total area? What will happen if it continues to melt earlier and freeze later?
2. How is the bear likely to try to respond to the changes? Can any of its existing adaptations help it cope with the changes in its habitat? The Polar bear is the sea bear. What risks is it likely to take in its search for food? The adult male bear is seen in **earth** attacking walrus and swimming far offshore.

Predators and Prey

IN THE FILM

earth features unique sequences of predation. Technical advances have made it possible to film some of the fastest and most deadly predators in action including the cheetah, lion and Great White shark. This remarkable footage shows, for the first time, in second-by-second detail, how these animals stalk and catch their prey. The sequences will make a riveting starting point for a study of feeding relationships focusing on how predators are adapted to locate, catch and kill their prey and how prey species are adapted to detect and avoid predators. They can also be used as the starting point for a study of food chains and food webs.

FOOD CHAIN FACTS …

- nearly every living thing on Earth is dependent on the sun's light for energy
- most of the sun's energy is trapped and converted into food by plants through photosynthesis
- energy is transferred from plants into animals by the herbivores that eat plants
- energy is transferred again as carnivores eat animals

THE LIONS OF CHOBE

LION FACTS…

- lions are the only cats to live socially in prides
- prides are made up of related females and could number 2 to 40 cats
- female cubs stay in their pride; males leave between the ages of 2 and 4
- the males in a pride are incomers who have taken over control from other males
- male lions are the only cats with manes
- lions roar to establish their territory and to communicate with pride members
- a lion can run for short distances at 50 mph (80 kph) and leap as far as 36 ft (11 m)

Lions live all over sub-Saharan Africa in plains or savannahs where they have a plentiful supply of prey on which to feed.

earth follows the lions of Chobe national park in Northern Botswana.

SAVANNAH FACTS…

- 'savannah' is the name given to grassland in Africa
- grasslands are one of the Earth's major terrestrial biomes
- grasslands are large open spaces with few bushes and trees
- large herds of grazing mammals live on grasslands
- grass feeds more animals than any other plant does

The lions of Chobe national park live in some of the largest prides in Africa. A pride could be as many as 30 strong. In these numbers they are a major threat to the animals that come to the park's water holes. Usually, the lions prey on smaller mammals like Thomson's gazelles, zebras, impalas and wildebeest, although some prides do target larger animals like buffalo and giraffes.

THE STRENGTH OF A LION

Lions are powerful cats. They have broad heads and thick, strong legs. Their back legs are designed to spring and their front legs to grab. They do both of these in bringing down their prey. When a lion is jumping, the tail plays an essential part in maintaining its balance.

STALKING AND STRIKING

Lionesses in a pride do most of the hunting. They often work as team, which gives them a huge advantage. Some drive prey toward others who lie in wait. If their prey is some distance away, lions may move quite quickly towards them at first. As they get nearer they sink into their stalking posture with heads and bodies low and eyes fixed on their prey. They freeze if the prey turns in their direction, then move forward as the prey looks away, or down to continue feeding. If they're lucky, the lions will get within striking distance, around 20-30 yards (20-30 meters) from their prey. From that distance they can make a short rapid charge and pounce. As it pounces, a lion uses its front legs to slap or grab the prey, bringing it down, then killing it with a bite to the throat or neck from its powerful jaws.

HUNTING ELEPHANTS

Drought forces these two animals together as the elephants come to the few remaining water holes in a desperate search for water. The lions ignore the strong adult elephants and search out young calves or weak elephants. The hunt is not without risk for the lions. Elephants will use their trunks and tusks to beat off lions and some of the hunting pride will be injured in the chase. Elephant mothers will attack lions to protect their calves. No more than one in four of a lion pride's attempts to hunt an elephant will succeed. By hunting at night, they give themselves an advantage. A lion's night vision is far better than an elephant's. Where the lions do succeed, it is the sheer number of lions attacking that will bring an elephant down. An elephant carcass will feed the pride for a week.

THE CHEETAH HUNT

CHEETAH FACTS…

- it is the world's fastest land mammal
- it can accelerate from zero to 40 mph (65 kph) in three strides and to its full speed of 70 mph (113 kph) in seconds
- as it nears full speed a cheetah is running at about 3 strides per second
- its respiratory rate climbs from 60 to 150 breaths per minute during a high-speed chase
- it can only run 400 to 600 yards (360 to 550 meters) before it's exhausted

The sequence of the cheetah hunting in the Maasai Mara was filmed using for the first time an ultra high-speed "photron" camera. This can shoot one thousand frames a second and slows down the hunt by more than forty times. This slowing of the action makes it possible to see the physical features of the cheetah in extraordinary detail. Every frame of this sequence demonstrates how the cheetah's adaptations make it one of Earth's great predators.

BORN TO RUN

From the tip of its nose to the tip of its tail, the cheetah is built for speed and hunting. Its head is small and its face flat. This shorter muzzle length means that its large eyes are positioned to give it maximum binocular vision. Enlarged nostrils and extensive air-filled sinuses vastly aid its breathing. It has a powerful heart and large, strong arteries.

The cheetah's body is narrow and lightweight. It has long, slender feet and legs and specialized muscles which give it fast acceleration and allow greater swing to its limbs. Its hips and shoulders swivel on its highly flexible spine. This curves up and down as the cheetah runs and its limbs alternately bunch up and then extend, giving greater reach to its legs. As it runs, only one foot at a time touches the ground, and there are two points in its 20-to 25-foot (6 to 7.5 meter) stride when none of its feet are on the ground, as they are fully extended and then totally doubled up.

The cheetah's tail is long and muscular; it acts as a stabilizer for the animal by counteracting its body weight and preventing it from rolling when it makes a fast turn at speed. Its paws are less rounded than those of other cats and have hard pads that give the cheetah grip. It's the only big cat with short, blunt claws that cannot completely retract. These too grip the ground when the cheetah is running.

THE GREAT WHITE SHARK

GREAT WHITE SHARK FACTS…

- the Great White is the world's largest predatory fish
- a Great White can grow to 20 ft (6 meters) in length and can weigh up to 4,400 lbs (2,000 kilograms)
- a Great White can have around 3,000 teeth in its mouth at any one time
- a Great White's teeth are up to 3 in (7.5 cm) long

HUNTER FROM THE DEEP

The Great White shark is a streamlined swimmer and a deadly predator. It has a torpedo-shaped body, with a pointed snout and crescent-shaped tail. The white underbelly of the shark gives it its name. Its upper surface is gray to blue gray and blends with the color of the waters it inhabits. This gives it an advantage in hunting its prey.

The shark attacks its prey from below at a steep angle giving itself the best chance of being unnoticed. In making an attack, the Great White sometimes swims so fast that it actually jumps out of the water, as it is seen doing in **earth**. It is one of only a few sharks than can jump fully out of the water in this way.

The Great White's teeth are not used to chew. They rip their prey into mouth-sized pieces to be swallowed whole. The teeth are triangular, serrated and razor-sharp. They are located in rows. The first two rows are used on prey; the other rows rotate into place as they are needed. As teeth are lost, broken, or worn down, they are replaced by new teeth that rotate into place.

PREDATOR AND PREY: ACTIVITIES

GRADES K-2: WHO EATS WHAT?

Learning objective:

- to understand that animals, including humans, need food and water to survive

It may be best with younger children to focus less on predation and more on thinking about animals' need for food and water to survive. While some children may find it unremarkable or fascinating that animals hunt and eat other animals, to others this may be a new and perhaps disturbing thought. The predation sequences in the film do not dwell on the moment of feeding but do show in detail the hunt. If children wish to explore predation further, other activities can be adapted to a level appropriate for them.

Tasks

1. Talk about what children eat and drink. What different foods do they eat? Make a list of what they eat in a day. Do they know why they eat and drink?
2. What do children know about what the animals around them eat and drink? These could be animals in the wild, working animals, or family pets. Make a chart or a display of animals, including human animals, and their foods. Draw pictures of the animals and add labels to show their food.

GRADES 3-6: INTERDEPENDENCE AND FOOD CHAINS

Learning Objectives:

- to understand that living things in a habitat are interdependent
- to understand that food chains show feeding relationships and begin with the sun's energy
- to construct a food chain

Tasks

1. To understand the nature of a food chain it is key to understand that plants are the only living organisms that make their food and that they use energy from the sun to do this. An easy experiment to demonstrate this is watching the effect of keeping a plant in the dark for a week and then returning it to the light.
2. The deciduous forest sequence in **earth** is an ideal focus for a study of a woodland food chain. How many different plants and animals can children see in this sequence (e.g., snowdrops, daffodils, bluebells, red fox, thrush, red deer, caterpillar, cherry tree, oak tree)? Draw or paint a woodland background and add to it photographs or drawings of these woodland plants and animals. Try constructing a food chain for this woodland. Join up the plants and animals in the chain. A plant must be at the beginning of the food chain.
3. Talk about what would happen if one or more elements of the woodland food chain suddenly disappeared? What if a disease killed all the caterpillars? What would the consequence be?
4. Play "Mixed-Up Food Chains": put the food chains in order (e.g., grass-fox-rabbit, caterpillar-leaf-owl-sparrow-eagle, etc.)

GRADES 7-12: PREDATOR OR PREY?

Learning objectives:

- to understand that predators are adapted to locate, catch and kill their prey
- to understand that animals are adapted to their food source
- to understand that prey species are adapted to detect and avoid predators

Tasks

1. The sequences of predation in **earth** provide a superb, quality resource through which to explore the characteristics of the featured predators. What adaptations demonstrated by the animals featured in **earth** make them successful predators? How is each animal particularly adapted to its food source? Create a guide to each predator describing its adaptations and its prey. This could be a wall poster or booklet.
2. What adaptations do the animals have in common? What factors are different? Is it possible to say there are certain adaptations that most predators have (e.g., acute vision and sense of smell)? List the common adaptations.
3. What kind of adaptations do these animals' prey have that help them evade their predator and survive? Think about the caribou and Thomson's gazelle being hunted by the wolf and cheetah (e.g., speed, agility, stamina, acute senses, positioning of eyes, startle response, etc.)
4. Play "What Eats What?" Collect pictures of the animals in **earth** and research the food chains to which they belong. Put these on a card. Players all begin with four cards and try to collect the complete food chain by asking other players if they have the card they need. If they have it, other players must hand it over. If they don't have it, the player selects another card from those remaining in the pack. The winner is the player who lays down all their cards in food chain sets.
5. The deciduous forest sequence in **earth** could be used to create a food web. After making as many food chains as possible using the animals and plants in this sequence, these could be combined into a food web. Who can make the most chains and create the most intricate web?
6. Discuss how changes happening in the world today might threaten the plants and animals in a food chain.

Life Cycles

IN THE FILM

earth is filled with enchanting, intimate, and dramatic scenes in which three of the great mammals rear and care for their offspring. **earth** shows, in all its intensity, the power of an animal's instinct to nurture and protect its offspring. From the mother Polar bear ignoring her own hunger as she patiently waits for the right moment to coax her cubs out on the Arctic sea ice, to the weary and parched African elephant mother on her long trek for water, turning back along her tracks to urge on the exhausted calf behind her, to the mother Humpback urgently slapping her fins on the ocean's surface to keep contact with her calf in the stormy waters of a southern ocean. As well as this, **earth** shows some of the most engaging and comic behavior found among bird species: the elaborate mating displays of the Birds of Paradise and the high-diving antics of Mandarin duck chicks.

LIFE CYCLE FACTS…

- all living things have a life cycle, from the tiniest bacteria to the gigantic Blue whale
- a life cycle is a series of stages a living organism goes through from its birth to its death
- a life cycle includes birth, life as a youngster, adolescence, adulthood, mating, caring for offspring and death
- throughout this cycle, each individual's aim is to develop, grow and learn enough to survive, and pass on its genes to its young
- the life cycles of many animals are intricately linked with the planet's seasons

THE AFRICAN ELEPHANT

AFRICAN ELEPHANT FACTS…

- the age at which elephants reach maturity varies with the environmental conditions
- female elephants generally become ready to mate when they are about 14 years old, but have been known to mate until they are nearly 60; males are around 20 before they mate
- the peak of breeding is in the rainy season though elephants can breed at any time
- female elephants have one of the longest pregnancies of the animal world: 22 months
- elephants give birth to a single calf and have to wait a minimum of 2 to 4 years between pregnancies
- calves measure about 3 ft. (0.8 - 1.05 meters) at the shoulder at birth and weigh about 200-260 lbs (90-120 kg)
- elephants grow to become the biggest animals on land, and can reach 13 ft. (4 meters) in height and weigh up to 10 tons
- elephants can live for 70 years

THE NEWBORN CALF

Other females often gather around a calving elephant. When the calf is born they sometimes give assistance to the mother as she uses her feet, trunk and tusks to help the calf stand. Newborn elephant calves try to stand almost immediately. On average it takes them about 30 minutes. They are born with their eyes open and functional, and as soon as they are on their feet they search for their mother's nipples. A calf's mother may bend her legs to help the calf reach her and start suckling. Elephant calves suckle frequently: at least every hour.

When they're first born, calves can have poor trunk control and they may be shaky on their legs for a few days but, by the time they're two days old, they can usually move with the herd.

THE GROWING CALF

Elephant calves are entirely dependent on their mothers for milk at first, but they begin playing with the vegetation they will eventually eat – leaves, bark, shrubs and roots – very early. They learn about it by investigating and tasting food taken from their mother's mouth, although they don't actually swallow any grass until they're about four months old.

Elephant calves have to learn everything from eating grass to how to drink water using their trunk. It can take up to six months for a calf to learn how to use its trunk to bring water up to its mouth. By six months, elephant calves are eating a significant amount of vegetation, and, by the time they're two years old, they spend as much of their time eating as the adults do. They continue suckling until they're at least two years old, but after six months they do it

less often. If a calf loses its mother before the age of two it is unlikely to survive. Some calves go on suckling to three, four or older.

Calves stay very close to their mother for about the first six months of their lives and then begin to move further away, to explore and play with other calves. Young calves play enthusiastically! They chase around rolling over each other, having pretend fights and generally rough and tumbling with each other. As they get older they do this less.

MOTHER AND CALF

The bond between a mother and her calf is strong. For the first few months of its life the mother watches her calf very closely and is very protective. She helps it whenever necessary, but she will also give it a slap with her trunk if she needs to discipline it. As a calf gets older its mother pays it less attention, but elephant calves remain dependent on adults for several years. In times of danger, the adults in a herd will form a ring around the young, facing out to protect them. All the mothers share the caring responsibility for an older calf with its mother. These surrogate mothers are young female elephants who are usually the calf's aunts or older sisters. They form strong bonds with the calf and will look after it while the mother feeds. In caring for the calves, the non mothers learn the mothering skills they will eventually need.

THE MATRIARCH

A female calf is likely to stay with the herd for the rest of its life. Male calves stay with the herd until they are old enough to mate and then they leave. At first, the males form small herds of their own called bachelor herds, but eventually they become solitary. Although males grow to be bigger than females, a female becomes the leader of the herd: the matriarch.

THE POLAR BEAR

POLAR BEAR FACTS…

- for most of their lives, Polar bears are solitary, coming together only for the breeding season
- females have their first cubs at around 5 years old
- males are around 6 years old when they breed
- Polar bears breed every two to four years
- the female gives birth to 1-4 cubs, usually 2
- Polar bears are born with their eyes closed
- they weigh around 1.3 lb (0.6 kg) at birth and are around 12 in long (30 cm)
- by the time they leave the maternity den they weigh around 22-23 lb (10- 15 kg)
- females and their cubs usually stay together for 2.5 years
- Polar bears grow to be the largest land predator in the world; males can grow up to around 8 ft (around 2.6 m) and can weigh up to 1,800 lbs (around 800 kg)
- adult Polar bears can live to be 30 years
- a Polar bear spends most of its life doing nothing but sleeping or lying still

MATING

Adult Polar bears mate between late March and early May. This is the only time when bears come together in the entire year. A breeding pair will stay together for 1-2 weeks before parting.

THE MATERNAL DEN

A pregnant Polar bear digs her maternity den in the snow around September or October. She chooses a site high up on snowy slopes to give her cubs protection from male Polar bears. The much bigger male finds it difficult to climb through the snow. While the temperature outside may drop as low as -58°F (-50°C), the den will stay at around 32°F (0°C).

Polar bears begin life inside the den.The cubs, usually two, are born between November and February. They grow rapidly feeding on their mother's rich breast milk and remain in the den until spring. During all that time the mother doesn't eat, drink, or defecate.

OUT ON TO THE SNOW

By the time the cubs leave the den with their mother, as they are seen doing in **earth**, they are strong enough to withstand the freezing temperatures outside. Their mother encourages them to take their first steps on the snowy landscape they will need to master by delaying feeding them until they are outside the den. Hunger is a powerful motivator. The cubs stay in the care of their mother for 2-3 years. The father plays no part in rearing them. By the time they are about three months old, they are starting to take solid food but they will not be fully weaned from their mother until they are 2-3 years old.

THE CURIOUS BEAR

During the time they spend with their mother the cubs' main task is to grow and to learn. Polar bears are curious animals. They watch their mother as she hunts for seals on the sea ice. They don't hunt themselves, she provides all the food for them, but they are learning hunting techniques from her. Cubs won't leave their mother until they can fend for themselves. Even with all the mother's care, only 50% of the cubs survive their first year. More will be lost in that dangerous period when they first leave their mother to make their way alone.

THE HUMPBACK WHALE

HUMPBACK WHALE FACTS…

- Humpback whales breed when they are around 4-6 years old
- gestation takes 11-12 months
- at birth they are 10-15 feet (4-5 meters) long and weigh up to 1 metric ton
- a female usually gives birth to 1 calf every 1-3 years
- calves drink 160 gallons (around 600 liters) of milk a day
- calves are weaned around 5 months
- calves stay with their mothers for at least 2 years
- Humpback whales grow to be about 52 feet (16 m) long, weighing 25-40 metric tons
- Humpbacks can live to around 45-50 years

THE SINGING WHALE

Humpback whales breed in the warm tropical waters just north and south of the Equator. It's here that the male whales sing their long and complex, eerily beautiful songs. Why or how Humpbacks sing is still unknown. Both males and females do it, though only males sing the lengthy intricate songs. It seems possible it is related to communication and in the case of the songs sung in the breeding season, connected in some way with mating.

During the breeding season Humpbacks demonstrate courting behaviors like rubbing and stroking each other and slapping the water with their fins. Once they have mated, it is left to the females to raise the young.

MOTHER LOVE

A Humpback calf is born near the surface and instinctively swims towards fresh air to take its first breath. Like all whales, Humpbacks breathe air. They breathe through two blowholes on the top of their heads and need to "spout" at the surface several times a minute or more after they've surfaced from a deep dive. A Humpback mother will use her flippers to help her calf to the surface, but within thirty minutes of being born, the calf will be able to swim.

The calf suckles on its mother in tropical seas for four to five months. During this time it grows rapidly. Its mother's milk is high in energy. For these months the mother cannot feed at all. The waters don't contain enough food. She survives on her blubber.

Once the calf is strong enough, it will join its mother on the yearly migration of thousands of miles to the polar waters in order to feed. The mother and calf stay together for up to 2 years. During that time the young whale will learn from its mother where the best feeding grounds are and the migration routes it will use in the future.

THE MANDARIN DUCK

MANDARIN DUCK FACTS…

- the Mandarin duck breeds in eastern Siberia, China, and Japan and winters in southern China and Japan
- there are some sedentary pairs residing in the United Kingdom
- Mandarins do not pair for life; males find new mates every breeding season
- a Mandarin clutch ranges from 9-12 eggs laid at daily intervals
- incubation lasts 28-29 days
- chicks fly when about 40-45 days old

Mandarin ducks breed in woodland areas near lakes, marshes or ponds. They always build their nests in a hole in a tree up to thirty feet from the ground. The female lines the nest with down.

HIGH DIVING DUCKS

In **earth** the Mandarin chicks are seen leaving the nest in spectacular style! When all the eggs are hatched, the mother calls to them from the ground. Each chick crawls out of the hole and launches itself into a free fall. Astonishingly, all the chicks land unhurt and head for the nearest feeding ground.
A Mandarin duck's diet is made up of water plants, rice and grains. Once they can fly the chicks will leave to join a new flock.

THE BIRD OF PARADISE OF PAPUA NEW GUINEA

BIRD OF PARADISE FACTS …

- there are around 40 different Bird of Paradise species in Papua New Guinea, each with a different display
- males of some species take up to 5 years to mature and acquire their spectacular plumage: feathers ruffs, elongated and elaborate sets of feathers, head plumes and breast plates, etc.
- females breed in their second year
- after mating a female builds a nest and raises the 1, 2 or perhaps 3 young alone
- it is thought that Birds of Paradise are relatively long-lived birds, with some species living for more than 12 years

PUTTING ON A SHOW

Courtship for Birds of Paradise has been elevated to an art form: a piece of theatre. Fruit is relatively abundant in the Papua New Guinean rainforest that is their habitat. As a result, the birds don't need to spend a lot of time searching for food and females don't need males to help them feed or protect their young. This has left the males with time to spend on the business of courtship, which has evolved into gaudy visual and auditory displays worthy of the most spectacular musical on stage or screen!

Some males display alone and some in groups. **earth** has a front-row seat for the display of the male Six Plumed Bird of Paradise. Technical developments in filming have made it possible to see the details of this display, which takes place in the low light of the forest floor. Every showman needs a stage, and the Six Plumed is no exception. He first builds his dance floor, clearing a small patch of forest floor of leaves and twigs, and pruning the surrounding branches of leaves. He doesn't want anyone to have a restricted view! He needs all visiting females to get a good look at his performance. If any undesirable leaf lands on his stage he will jump to remove it just in case it deters a choosy passing female!

The Superb Bird of Paradise, also seen in **earth**, takes a different approach. He relies on sound to advertise his show before he even begins. Once he has a female's attention he uses a combination of sound and his newly revealed iridescent plumage to woo her: with, or without, success!

LIFE CYCLES: ACTIVITIES

GRADES K-2: ALL KINDS OF BABIES

Learning objectives:

- to understand that humans are animals
- to understand that animals grow and change as they get older

earth features charming and fascinating sequences of animals caring for their young and can provide younger children with an exciting springboard from which to begin thinking about animal reproduction and growth.

Tasks

1. How many different animals can children remember seeing with their babies in the film? Who can remember the most? Can they make a list of them? What do they remember about what they saw them doing? Draw pictures of scenes from the film and write captions describing what is happening.
2. Using this list of animals in **earth,** begin collecting pictures for a scrapbook of the animals and their babies. Compare the adult with the baby animal. How are they different? How are they the same?
3. Choose one of the animals featured in the film and find out more about it to add to the scrapbook. What is it like when it's born? Can it see? How big is it? Can it walk?
4. Write a story about a baby animal that loses its mother. How does it find her again?
5. Many children will already have knowledge of animal reproduction and rearing that they have acquired perhaps from working animals if they live in an agricultural context, from pets, or from observation of wildlife in their immediate environment. They can include information on "Animals I Know" in their scrapbook.
6. The baby animals in **earth** all resemble the adults physically, but this is not true of all babies. Can children think of any baby animals that do not look at all like the adult animal? (tadpoles and frogs, caterpillars and butterflies)
7. Can the children compare themselves and their brothers and sisters with the animals they see in **earth**? In what ways are human babies like the animal babies and in what ways are they different?

GRADES 3-6: GROWING UP

Learning objectives:

- to understand that animals produce offspring that grow from young animals to adults and then reproduce themselves
- to understand that in every life cycle there are distinct processes and stages

The animals in **earth** shown with their young are mainly mammals and birds. The film provides a good opportunity for older children to explore the nature of mammalian reproduction and contrast this with bird reproduction.

Tasks

1. Focus on one of the mammals in **earth** and explore how the baby changes as it grows. Then, write the mammal's life story from birth to the time when it reproduces itself. Tell the story in pictures with each stage of the growing animal's life shown in a different frame and captioned. Turn the drawings into a picture book.

2. Focus on the sequences featuring the mammals (Polar bear, caribou, elephant, whale). What do the cubs and calves have in common and what is different about them (e.g., they are born 'live', they suckle their mothers, they stay with their mothers for extended periods, they are warm-blooded, but they are very different in size when born, their mobility is very different etc.)? Create a chart of similarities and differences.

3. Focus on one of the mammals and compare the baby with a human baby. Create a timeline for the first five years in each of their lives. How are they similar and how are they different? Make a list of the similarities and differences.

4. Use the Mandarin duck sequence as the focus for studying a bird life cycle. How is it different from that of a mammal?

5. How do the mothers in the film care for their young? What needs do the offspring have that their mother must fulfill? The film shows how well a mother animal cares for her offspring. Why do children think this drive in a mother animal is so strong? What would happen if it was not? This will introduce the idea of survival of a species.

6. Design a new Bird of Paradise. How will it display? Create the bird using brightly colored art materials.

GRADES 7-12: ENDANGERED

Learning objectives:

- to investigate how a species becomes endangered
- to explore the role of international cooperation in the protection of endangered species

For a species to survive it must reproduce. These species provide an ideal focus for a discussion of how a species' population can begin to fall, become endangered and can recover. These stories demonstrate how human actions can both threaten and save another species.

A GIANT UNDER THREAT: THE AFRICAN ELEPHANT

For thousands of years elephants have been exploited for their ivory tusks. Humans have been hunting elephants ever since the two came into contact, but it became widespread in the 19th and 20th centuries with the use of guns. In just one country, Kenya, the elephant population fell from 167,000 in 1973 to 19,000 in 1989. Although hunting has decreased since the ivory ban came into effect in 1990, it still continues.

Hunting fundamentally changes the structure of elephant populations. The adult males and the matriarchs of a herd are most frequently the target of hunters because of their large tusks. This has left so few males in some areas that female elephants may be unable to find a mate in order to breed. The death of a matriarch impacts the herd as a whole since she is the holder of so much knowledge. She needs to pass that on to younger members of the family unit she leads if it is going to survive and members are going to reproduce.

Loss and fragmentation of their habitat is also putting elephant populations at risk as human settlement takes over land that was once the elephants' range bringing elephants and humans into direct conflict. Where elephants do damage to agriculture, water supplies or even people, they may be killed.

ON THE VERGE OF EXTINCTION: THE AMUR LEOPARD

The territory of the Amur leopard is in north–east Siberia near North Korea. A census of the Amur leopard in February and March 2007 showed that less than 40 of these animals remain in the wild. The census recorded four leopard litters, which means that the existing population can still restore itself. However, for the long-term survival of the species a population of one hundred animals is needed.

A series of factors are quoted as being responsible for this catastrophic decline in numbers: the encroachment into the leopard's territory of human settlement, the building of

roads, poaching of the leopard for its beautiful pelt, the intensive exploitation of forests through logging and the impact of climate change. The Russian World Wildlife Fund is calling for the establishment of a protected area with national park status to protect the leopard. The difficulty is that large predators need large tracts of land on which to live. An adult leopard home range can be up to 200 sq miles (around 500 sq km) and typically includes forested land and deer. Deer, along with hares and badgers, are now found in lower numbers on the Amur leopard's range reducing the availability of its prey.

In early 2007 the Russian government decided after years of discussion and campaigning by wildlife groups that it would not permit an oil pipeline to be driven through the territory of the Amur leopard saying that the impact of the pipeline would have too damaging an impact on the Amur Bay and its wildlife populations.

BACK FROM THE BRINK: THE AMUR TIGER

In the 20th century the Amur tiger nearly died out. By the 1940s just 40 remained. But according to recent data from the World Wildlife Fund, the tiger population in the Sihote-Alinn mountains on the Russia-China border is now up to somewhere around 500. The tiger has made its recovery following a co-operative effort between Russia and China. The Soviet Union, as it then was, introduced a ban on poaching tigers in the 1950s and the Chinese government supported a global ban on tiger products.

However, tiger's hides can still command good prices in the black markets of northeast China. Therefore, poaching continues to be a source of income for impoverished local populations. The Russian World Wildlife Fund recently warned that the species continues to be critically endangered and would be at risk if China succeeded in lifting the global ban on tiger products.

Tasks

1. Compare the plight of the African elephant and the Amur leopard. What factors have threatened the survival of these animals? Are the factors affecting the elephant and the leopard the same or are there differences? Taking each of the factors in turn, discuss which are easier or more difficult to deal with.
2. Discuss the case of the Amur tiger. How did the actions taken internationally restore the tiger population?
3. What strategies do students think could be used to bring about an increase in the Amur leopard or African elephant populations? Students can investigate conservation projects mounted in the past and present to safeguard and renew the population of other endangered species to see if they could be applied to these animals. Which might be appropriate and which would be discounted?
4. Having investigated strategies, students can write their own 10-point plan to secure the future of the Amur leopard and/or the African elephant.

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