

## GLOBE Key Concepts LINKED to National Science Education Standards (NSES)

Primary links between GLOBE Key Concepts and NSES standards are indicated by non-italicized text; *secondary links are indicated by italicized text.*

ATMOSPHERE Concepts	NSES K - 4	NSES 5 - 8	NSES 9 - 12
1. Composition of the atmosphere; human influences on changes in the Earth's atmosphere	<p>Earth materials are solid rocks and soils, water, and the gases of the atmosphere. The varied materials have different physical and chemical properties....</p> <p><i>Humans change environments in ways that can be either beneficial or detrimental for themselves and other organisms.</i></p> <p><i>Changes in environments can be natural or influenced by humans. Some changes are good, some are bad, and some are neither good nor bad.</i></p>	<p>The atmosphere is a mixture of nitrogen, oxygen, and trace gases that include water vapor. The atmosphere has different properties at different elevations.</p> <p>Human activities also can induce hazards through resource acquisition, urban growth, land-use decisions, and waste disposal. Such activities can accelerate many natural changes.</p> <p>Maintaining environmental health involves establishing or monitoring quality standards related to use of.....air</p> <p><i>When an area becomes overpopulated, the environment will become degraded due to increased use of resources.</i></p> <p><i>Causes of environmental degradation and resource depletion vary from region to region and from country to country.</i></p>	<p>The earth does not have infinite resources: increasing human consumption places severe stress on the natural processes that renew some resources, and it depletes those resources that cannot be renewed.</p> <p>Humans use many natural systems as resources. Natural systems have the capacity to reuse waste, but that capacity is limited.</p> <p>Natural ecosystems provide an array of basic processes that affect humans. Those processes include maintenance of the quality of the atmosphere. Humans are changing many of these basic processes, and the changes may be detrimental to humans.</p> <p>Human activities can enhance potential for hazards. Acquisition of resources, urban growth, and waste disposal can accelerate rates of natural change.</p> <p>Humans live at the interface between the atmosphere driven by solar energy and the upper mantle ....</p> <p>Many changes in the environment designed by humans bring benefits to society, as well as cause risks.</p> <p>Humans have a major effect on other species. For example, ....., pollution – which changes the composition of air, soil and water.</p> <p>Human destruction of habitats through direct harvesting, pollution, atmospheric changes, and other factors is threatening global stability, and if not addressed, ecosystems will be irreversibly affected.</p>
2. Cloud formation (including water cycle) and identification	<i>The sun provides the light and heat necessary to maintain the temperature of the earth.</i>	<p>Water, which covers the majority of the earth's surface, circulates through the crust, oceans, and atmosphere in what is known as the "water cycle". Water evaporates from the earth's surface, rises and cools as it moves to higher elevations.....</p> <p>Clouds, formed by the condensation of water vapor, affect weather and climate.</p> <p>Global patterns of atmospheric movement influence local weather.</p> <p><i>The sun is a major source of energy for changes on the earth's surface.</i></p>	
3. Clouds can be used to forecast / predict the weather	" "		
4. Cooling/warming effect of clouds; effects of wind	" "		<p>Heating of the earth's surface and atmosphere by the sun drives convection within the atmosphere and oceans, producing winds and ocean currents.</p> <p>Global climate is determined by energy transfer from the sun at and near the earth's surface. This energy transfer is influenced by dynamic processes such as cloud cover and the earth's rotation, and static conditions such as the position of mountain ranges and oceans.</p> <p><i>Earth systems have internal and external sources of energy, both of which create heat. The sun is the major external source of energy.</i></p>
5. Earth's heat transfer is influenced by movement of water in the atmosphere	" "		<p>Heating of the earth's surface and atmosphere by the sun drives convection within the atmosphere and oceans, producing winds and ocean currents.</p>
6. Density (of rain, snow)		A substance has characteristic properties, such as density.....	

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ATMOSPHERE Concepts	NSES K - 4	NSES 5 - 8	NSES 9 - 12
7. Change of state; energy changes and changes in state; heat capacity	Materials can exist in different states – solid, liquid, and gas. Some common materials, such as water, can be changed from one state to another by heating or cooling.		
8. Acids, bases, pH, pH measurement, buffers; acid precipitation and its effects			
9. Heat and temperature	Heat can be produced in many ways, such as burning, rubbing or mixing one substance with another.	Energy is transferred in many ways. Heat moves in predictable ways, flowing from warmer objects to cooler ones, until both reach the same temperature.	Heat consists of random motion and the vibrations of atoms, molecules, and ions. The higher the temperature, the greater the atomic or molecular motion.
10. Heat transfer through radiation, conduction, and convection;	Heat can move from one object to another by conduction.		Everything tends to become less organized and less orderly over time. Thus, in all energy transfers, the overall effect is that the energy is spread out uniformly. Examples are the transfer of energy from hotter to cooler objects by conduction, radiation, or convection ....
11. Different substances transfer energy and heat at different rates; some materials are good conductors, some are good insulators			
12. Substances expand and contract as the temperature changes; coefficient of expansion			
13. Classification helps us organize and understand the natural world.	Objects can be categorized into two groups, natural and designed.		Biological classifications are based on how organisms are related. Organisms are classified into a hierarchy of groups and subgroups based on similarities which reflect their evolutionary relationships.
14. Models allow you to: study a process or phenomenon that would be difficult to study in other ways; compare the predicted values (using the model) and the measured values; modify input parameters in order to predict realistic changes in output.	<i>People have always had questions about their world. Science is one way of answering questions and explaining the natural world.</i> <i>People have always had problems and invented tools and techniques (ways of doing something) to solve problems. Trying to determine the effects of solutions helps people avoid some new problems.</i> <i>Tools help scientists make better observations, measurements, and equipment for investigations. They help scientists see, measure, and do things that they could not otherwise see, measure, and do.</i>	<i>Technology is essential to science, because it provides instruments, and techniques that enable observations of objects and phenomena that are otherwise unobservable due to factors such as quantity, distance, location, size and speed. Technology also provides tools for investigations, inquiry and analysis.</i>	

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HYDROLOGY Concepts	NSES K - 4	NSES 5 - 8	NSES 9 - 12
1. Surface water exists in many forms and has many observable characteristics, such as temperature, color, smell, flow and shape.	Earth materials are solid rocks and soils, water, and the gases of the atmosphere. The varied materials have different physical and chemical properties....	<i>Water evaporates from the earth's surface, rises and cools as it moves to higher elevations, condenses as rain or snow, and falls to the surface where it collects .....</i>	
2. Water characteristics are closely related to the characteristics of the surrounding land.	<i>The surface of the earth changes. Some are due to slow processes, such as erosion and weathering....</i>	Water is a solvent. As it passes through the water cycle it dissolves minerals and gases ....	
3. Water moves from one location to another (including the hydrologic cycle); moving water erodes the land.	The surface of the earth changes. Some are due to slow processes, such as erosion and weathering.... Some environmental changes occur slowly, and other occur rapidly. Student should understand the different consequences of changing environments in small increments over long periods as compared with changing environments in large increments over short periods.	Water is a solvent. As it passes through the water cycle it dissolves minerals and gases .... Land forms are the result of a combination of constructive and destructive forces....destructive forces include weathering and erosion.	
4. The nature of a watershed is determined by the physical features of the land.			
5. A watershed guides all precipitation and run off to a common watercourse or body of water.	<i>The surface of the earth changes. Some are due to slow processes, such as erosion and weathering....</i>		
6. Human activities (including land development) affects water sources and the watershed	Humans change environments in ways that can be either beneficial or detrimental for themselves and other organisms. Changes in environments can be natural or influenced by humans. Some changes are good, some are bad, and some are neither good nor bad.	Human activities also can induce hazards through resource acquisition, urban growth, land-use decisions, and waste disposal. Such activities can accelerate many natural changes. Maintaining environmental health involves establishing or monitoring quality standards related to use of .... Water <i>When an area becomes overpopulated, the environment will become degraded due to increased use of resources.</i> <i>Causes of environmental degradation and resource depletion vary from region to region and from country to country.</i>	The earth does not have infinite resources; increasing human consumption places severe stress on the natural processes ... Natural systems have the capacity to reuse waste, but that capacity is limited. Natural systems can change to an extent that exceeds the limits of organisms to adapt naturally or human to adapt technologically. Natural ecosystems provide an array of basic processes that affect humans....Humans are changing many of these basic processes, and the changes may be detrimental to humans. Acquisition of resources, urban growth, and waste disposal can accelerate rates of natural change. Many changes in the environment designed by humans bring benefits to society, as well as cause risks. Humans have a major effect on other species. For example, ....., pollution – which changes the composition of air, soil and water. Human destruction of habitats ... is threatening global stability, and if not addressed, ecosystems will be irreversibly affected.

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HYDROLOGY Concepts	NSES K - 4	NSES 5 - 8	NSES 9 - 12
7. Each organism has a range of water characteristics needed for survival and dictate its adaptability to a changing environment.	Organisms have basic needs.... Organisms can survive only in environments in which their needs can be met. The world has many different environments, and distinct environments support the life of different types of organisms.	All organisms must be able to obtain and use resources, grow, reproduce, and maintain stable internal conditions while living in a constantly changing external environment.	Living organisms have the capacity to produce populations of infinite size, but environments and resources are finite. This fundamental tension has profound effects on the interactions between organisms.  The distribution and abundance of organisms and populations in ecosystems are limited by the availability of matter and energy and the ability of the ecosystem to recycle materials.
8. Macro-invertebrates are sensitive indicators of water quality.			
9. Water transparency and its affects on the growth of photosynthetic plants.		The number of organisms an ecosystem can support depends on the resources available and abiotic factors, such as ...water	The distribution and abundance of organisms and populations in ecosystems are limited by the availability of matter and energy and the ability of the ecosystem to recycle materials.
10. Water chemistry is an important aspect of habitat requirements and affects species diversity and annual survivability.		The number of organisms an ecosystem can support depends on the resources available and abiotic factors, such as ...water	
11. Water quality can be described using measurements that include temperature, dissolved oxygen, Acids, bases, pH, pH measurement, buffers, salinity	Objects have many observable properties, including size, weight, shape, color, temperature, and the ability to react with other substances.	Maintaining environmental health involves establishing or monitoring quality standards related to use of .... water	
12. Acids, bases, pH, pH measurement, buffers: the effect of acid rain, acid lakes and acid streams			
13. The role of water in chemical reactions; solutions, solvents, suspensions	<i>Objects have many observable properties, including size, weight, shape, color, temperature, and the ability to react with other substances.</i>	A substance has characteristic properties, such as .....solubility  Substances react chemically in characteristic ways with other substances to form new substances....  Water is a solvent.....	Chemical reactions occur all around us, .....
14. Temperature, heat, heat transfer	Heat can be produced in many ways, such as burning, rubbing or mixing one substance with another.  Heat ca move from one object to another by conduction.	Energy is transferred in many ways.  Heat moves in predictable ways, flowing from warmer objects to cooler ones, until both reach the same temperature.	Heat consists of random motion and the vibrations of atoms, molecules, and ions. The higher the temperature, the greater the atomic or molecular motion.  Everything tends to become less organized and less orderly over time. Thus, in all energy transfers, the overall effect is that the energy is spread out uniformly. Examples are the transfer of energy from hotter to cooler objects by conduction, radiation, or convection ....
15. Electrical resistance, conductivity, factors affecting conductivity			
16. Dissolved solids in water including: salinity, alkalinity, nitrates		<i>A substance has characteristic properties, such as .....solubility.</i>	
17. Dissolved oxygen and factors that affect dissolved oxygen in water		Water is a solvent. As it passes through the water cycle it dissolves minerals and gases ....	
18. Specific gravity			
19. High and low tides			

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HYDROLOGY Concepts	NSES K - 4	NSES 5 - 8	NSES 9 - 12
20. Models allow you to: study a process or phenomenon that would be difficult to study in other ways; compare the predicted values (using the model) and the measured values; modify input parameters in order to predict realistic changes in output.	<i>People have always had questions about their world. Science is one way of answering questions and explaining the natural world.</i>	<i>Technology is essential to science, because it provides instruments, and techniques that enable observations of objects and phenomena that are otherwise unobservable due to factors such as quantity, distance, location, size and speed. Technology also provides tools for investigations, inquiry and analysis.</i>	
21. A map is a symbolic representation of a certain land area.	<i>People have always had problems and invented tools and techniques (ways of doing something) to solve problems. Trying to determine the effects of solutions helps people avoid some new problems.</i>		
22. Topographical maps provide 3-dimensional information about the land.	<i>Tools help scientists make better observations, measurements, and equipment for investigations. They help scientists see, measure, and do things that they could not otherwise see, measure, and do.</i>		
23. Classification helps us organize and understand the natural world.	Objects can be categorized into two groups, natural and designed.		Biological classifications are based on how organisms are related. Organisms are classified into a hierarchy of groups and subgroups based on similarities which reflect their evolutionary relationships.

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SOIL Concepts	NSES K - 4	NSES 5 - 8	NSES 9 - 12
1. Soil is composed of minerals, organic matter and open spaces.	Earth materials are solid rocks and soils, water, and the gases of the atmosphere. The varied materials have different physical and chemical properties....	Soil consists of weathered rocks and decomposed organic material ...	
2. Soils vary within a small local area; soil properties change over time.		Soils are often in layers, with each having a different chemical composition and texture. Maintaining environmental health involves establishing or monitoring quality standards related to use of soil....	Natural ecosystems provide an array of basic processes that affect humans. Those processes include maintenance of the quality of the .... generation of soils...and recycling of nutrients. Humans are changing many of these basic processes, and the changes may be detrimental to humans.  Human activities can enhance potential for hazards. Acquisition of resources, urban growth, and waste disposal can accelerate rates of natural change.  Many changes in the environment designed by humans bring benefits to society, as well as cause risks.
3. There are many soil types including: sand, silt, clay and loam.			
4. Soil can be classified according to its properties and soil profile (horizon, color, texture, root distribution, pH of soil, particle size distribution)	Soils have properties of color and texture, capacity to retain water, and ability to support the growth of many kinds of plants.....	Soils are often in layers, with each having a different chemical composition and texture.	
5. Soil properties are related to soil forming factors including: moisture content, temperature, land use, organisms, general climate, parent material and topography	" "		
6. Soils hold moisture; soil properties affect flow rate, water holding capacity, nutrient filtering ability	" "		
7. Infiltration is the rate at which water flows into the ground; the rate changes depending on the level of soil saturation; soil water content varies around the world.	" "		
8. Decomposition in soil depends upon different environmental conditions.	<i>Plants and animals have life cycles that include being born, developing into adults, reproducing and eventually dying.</i>	<i>Decomposers, primarily bacteria and fungi, are consumers that use waste materials and dead organisms for food.  The number of organisms an ecosystem can support depends on the resources available and abiotic factors, such as ...soil</i>	
9. Soil fertility is a measure of stored nutrients (esp. N, P, K)			
10. Soil is an important building material.	Earth materials provide many of the resources that humans use.		
11. Different substances transfer energy and heat at different rates; some materials are good conductors, some are good insulators; soil is an insulating layer	<i>Heat can move from one object to another by conduction.</i>		Everything tends to become less organized and less orderly over time. Thus, in all energy transfers, the overall effect is that the energy is spread out uniformly. Examples are the transfer of energy from hotter to cooler objects by conduction, radiation, or convection ....

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SOIL Concepts	NSES K - 4	NSES 5 - 8	NSES 9 - 12
12. Acids, bases, pH, pH measurement, buffers			
13. Chemical reactions	<i>Objects have many observable properties, including size, weight, shape, color, temperature, and the ability to react with other substances.</i>	Substances react chemically in characteristic ways with other substances to form new substances....	
14. Specific gravity			
15. Density; bulk density		A substance has characteristic properties, such as density.....	
16. Solutions, suspensions, particle size distribution, Stokes Law		A substance has characteristic properties, such as .....solubility	
17. Electrical resistance			
18. Models allow you to: study a process or phenomenon that would be difficult to study in other ways; compare the predicted values (using the model) and the measured values; modify input parameters in order to predict realistic changes in output.	<p><i>People have always had questions about their world. Science is one way of answering questions and explaining the natural world.</i></p> <p><i>People have always had problems and invented tools and techniques (ways of doing something) to solve problems. Trying to determine the effects of solutions helps people avoid some new problems.</i></p> <p><i>Tools help scientists make better observations, measurements, and equipment for investigations. They help scientists see, measure, and do things that they could not otherwise see, measure, and do.</i></p>	<p><i>Technology is essential to science, because it provides instruments, and techniques that enable observations of objects and phenomena that are otherwise unobservable due to factors such as quantity, distance, location, size and speed. Technology also provides tools for investigations, inquiry and analysis.</i></p>	

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LAND COVER Concepts	NSES K - 4	NSES 5 - 8	NSES 9 - 12
1. Earth systems have inputs including: sun's energy, water, carbon dioxide, oxygen, dust; and outputs including: water, carbon dioxide, oxygen, heat.		The sun is a major source of energy for changes on the earth's surface.	<i>Earth systems have internal and external sources of energy, both of which create heat. The sun is the major external source of energy.</i>
2. Earth system science studies the interactions of the atmosphere (air), hydrosphere (water), geosphere (land), biosphere (living organisms) and cryosphere (ice masses).			Interactions among the solid earth, the oceans, the atmosphere, and organisms have resulted in the ongoing evolution of the earth system.  <i>Heating of the earth's surface and atmosphere by the sun drives convection within the atmosphere and oceans, producing winds and ocean currents.</i>
3. System boundaries differ depending upon the question your study is asking.			
4. The GLOBE Study Site is a system with energy, water-, and C, N, O, and P biogeochemical cycles and elements such as trees, water, soil, rocks, and animals.	<i>Earth materials are solid rocks and soils, water, and the gases of the atmosphere. The varied materials have different physical and chemical properties....</i>	The sun is a major source of energy for changes on the earth's surface.	The earth is a system containing essentially a fixed amount of each stable chemical atom or element. Each element can exist in several different chemical reservoirs. Each element on earth moves among reservoirs in the solid earth, oceans, atmosphere, and organisms as part of geometrical cycles.  Movement of matter between reservoirs is driven by the earth's internal and external sources of energy.  The atoms and molecules on the earth cycle among the living and nonliving components of the biosphere.  <i>Earth systems have internal and external sources of energy, both of which create heat. The sun is the major external source of energy.</i>
5. Characteristics of the GLOBE Study Site include: pixel Size, canopy cover, ground cover, tree height and circumference, grass biomass, dominant and co-dominant species, GPS location, field measurements/biometry			<i>The distribution and abundance of organisms and populations in ecosystems are limited by the availability of matter and energy and the ability of the ecosystem to recycle materials.</i>
6. Biometry is the measurement of ground sites dominated by vegetation.			
7. Landcover can be divided into the study of the canopy and the study of ground cover			
8. Most of the Earth's surface is covered by naturally vegetated ecosystems which evolved in response to local geographic and climatic conditions.	Many characteristics of an organism are inherited from the parents of the organisms, but other characteristics result from an individual's interactions with the environment.	The characteristics of an organism can be described in terms of a combination of traits. Some traits are inherited and others result from interactions with the environment.  All populations living together and the physical factors with which they interact compose an ecosystem.	Interactions among the solid earth, the oceans, the atmosphere, and organisms have resulted in the ongoing evolution of the earth system.  Species evolve over time.  The great diversity of organisms is the result of more than 3.5 billion years of evolution that has filled everyavailable niche with life forms.



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LAND COVER Concepts	NSES K - 4	NSES 5 - 8	NSES 9 - 12
9. Plants absorb and cycle nutrients and water.	Organisms have basic needs. For example, .... Plants require air, water, nutrients and light.	All organisms must be able to obtain and use resources ....	Plants.... use solar energy to combine molecules of carbon dioxide and water into complex, energy rich organic compounds and release oxygen to the environment. This process of photosynthesis provides a vital connection between the sun and the energy needs of living systems.
10. Plants form the basic foundation of food chains.	All animals depend on plants.	Energy entering ecosystems as sunlight is transferred by producers into chemical energy through photosynthesis. That energy then passes from organisms to organism in food webs.	Plants.... use solar energy to combine molecules of carbon dioxide and water into complex, energy rich organic compounds and release oxygen to the environment. This process of photosynthesis provides a vital connection between the sun and the energy needs of living systems.
11. Plants and animals have specialized body parts adapted to living in a particular environment and are affected when land cover types change.	Each plant or animal has different structures that serve different functions in growth, survival, and reproduction. When the environment changes, some plants and animals survive and reproduce, and others die or move to new locations. <i>The behavior of individual organisms is influenced by ... external cues (such as a change in the environment).</i>	Living systems at all levels of organization demonstrate the complementary nature of structure and function. How a species moves, obtains food, reproduces, and responds to danger are based in the species' evolutionary history. An organism's behavior evolves through adaptation to its environment	The complexity and organization of organisms accommodates the need for obtaining, transforming, transporting, releasing and eliminating the matter and energy used to sustain the organisms. The distribution and abundance of organisms and populations in ecosystems are limited by the availability of matter and energy and the ability of the ecosystem to recycle materials.
12. Humans have extensively modified and replaced natural vegetation and type of land cover	Humans change environments in ways that can be either beneficial or detrimental for themselves and other organisms. Changes in environments can be natural or influenced by humans. Some changes are good, some are bad, and some are neither good nor bad.	When an area becomes overpopulated, the environment will become degraded due to increased use of resources. Causes of environmental degradation and resource depletion vary from region to region and from country to country.	The earth does not have infinite resources; increasing human consumption places severe stress on the natural processes that renew some resources, and it depletes those resources that cannot be renewed. Humans use many natural systems as resources. Natural systems have the capacity to reuse waste, but that capacity is limited. Natural systems can change to an extent that exceeds the limits of organisms to adapt naturally or human to adapt technologically. Many changes in the environment designed by humans bring benefits to society, as well as cause risks. Humans have a major effect on other species. Human destruction of habitats through direct harvesting, pollution, atmospheric changes, and other factors is threatening global stability, and if not addressed, ecosystems will be irreversibly affected. The distribution and abundance of organisms and populations in ecosystems are limited by the availability of matter and energy and the ability of the ecosystem to recycle materials.
13. Classification helps us organize and understand the natural world; dichotomous keys can be used to classify living organisms.	Objects can be categorized into two groups, natural and designed.		Biological classifications are based on how organisms are related. Organisms are classified into a hierarchy of groups and subgroups based on similarities which reflect their evolutionary relationships.
14. Magnetism, magnets, magnetic compasses	Magnets attract and repel each other and certain kinds of other materials.		Electricity and magnetism are two aspects of a single electromagnetic force.

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ATMOSPHERE Concepts	NSES K - 4	NSES 5 - 8	NSES 9 - 12	
15. The field of view is the area your eye or camera's eye can perceive; it increases the higher the eye is relative to the ground.	Tools help scientists make better observations, measurements, and equipment for investigations. They help scientists see, measure, and do things that they could not otherwise see, measure, and do.	Technology is essential to science, because it provides instruments, and techniques that enable observations of objects and phenomena that are otherwise unobservable due to factors such as quantity, distance, location, size and speed. Technology also provides tools for investigations, inquiry and analysis.		
16. Student remote sensing involves observations made without the use of touch i.e. using eyes, ears, nose and skin surface				
17. Satellite remote sensing uses cameras sensitive to different wavelengths.		The sun's energy arrives as light with a range of wavelengths, consisting of visible light, infrared, and ultraviolet radiation.  <i>Technology is essential to science, because it provides instruments, and techniques that enable observations of objects and phenomena that are otherwise unobservable due to factors such as quantity, distance, location, size and speed. Technology also provides tools for investigations, inquiry and analysis.</i>		
18. Thermal radiation photography uses sensors to read the amount of heat radiated by an object; then interpret and digitize the information into a code.		<i>Technology is essential to science, because it provides instruments, and techniques that enable observations of objects and phenomena that are otherwise unobservable due to factors such as quantity, distance, location, size and speed. Technology also provides tools for investigations, inquiry and analysis.</i>		
19. Image display is accomplished by conversion of stored data to a user-defined by color-coded image and creating a picture based on differences in the reflectance of light.		Light interacts with matter by transmission (including refraction), absorptions, or scattering (including reflection).  <i>Technology is essential to science, because it provides instruments, and techniques that enable observations of objects and phenomena that are otherwise unobservable due to factors such as quantity, distance, location, size and speed. Technology also provides tools for investigations, inquiry and analysis.</i>		
20. Models allow you to: study a process or phenomenon that would be difficult to study in other ways; compare the predicted values (using the model) and the measured values; modify input parameters in order to predict realistic changes in output.		<i>People have always had questions about their world. Science is one way of answering questions and explaining the natural world.</i>  <i>People have always had problems and invented tools and techniques (ways of doing something) to solve problems. Trying to determine the effects of solutions helps people avoid some new problems.</i>	<i>Technology is essential to science, because it provides instruments, and techniques that enable observations of objects and phenomena that are otherwise unobservable due to factors such as quantity, distance, location, size and speed. Technology also provides tools for investigations, inquiry and analysis.</i>	
21. A map is a symbolic representation of a certain land area.		<i>Tools help scientists make better observations, measurements, and equipment for investigations. They help scientists see, measure, and do things that they could not otherwise see, measure, and do.</i>		

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SEASONS Concepts	NSES K - 4	NSES 5 - 8	NSES 9 - 12
1. Earth systems have inputs including: sun's energy, water, carbon dioxide, oxygen, dust; and outputs including: water, carbon dioxide, oxygen, heat.	The sun provides the light and heat necessary to maintain the temperature of the earth.	The sun is a major source of energy for changes on the earth's surface.	
2. System boundaries differ depending upon the question your study is asking			
3. The Earth's axis of rotation is inclined with respect to the plane of its orbit around the sun; this causes seasonal changes that are driven by changes in the amount of the sun's energy reaching the Earth's surface.	Objects in the sky have patterns of movement. The sun, for example, appears to move across the sky in the same way every day, but its path changes slowly over the seasons.	The sun is the major source of energy for phenomena on the earth's surface .... Seasons result from variations in the amount of the sun's energy hitting the surface, due to the tilt of the earth's rotation on its axis and the length of the day.	
4. Sun - Earth seasonal relationships (solstice, equinox)			
5. Seasons have distinct characteristics.			
6. Seasonal changes demonstrate the interconnections among Earth's systems.			
7. Seasonal patterns differ based on geographic locations.			
8. Seasonal changes follow an annual cycle which can change from year to year.			
9. Seasonal temperature cycles vary..			
10. Seasonal patterns are influenced by latitude, elevation and geography.			
11. Seasonal changes impact the atmosphere, ecology (plant and animal adaptations), the soil and the hydrologic cycle			
12. Bud-break is the period in spring when leaf buds appear and grow.			
13. Senescence is the period in the fall when actively growing plant material dies.			
14. The Earth has many climate zones: polar, tropical, temperate, continental & marine.	<i>The sun provides the light and heat necessary to maintain the temperature of the earth.</i>	The sun is a major source of energy for changes on the earth's surface.	
15. The amount of precipitation is affected by the amount of water vapor in the air and the temperature.			Heating of the earth's surface and atmosphere by the sun drives convection within the atmosphere and oceans, producing winds and ocean currents.
16. The rising of heated air & sinking of cooled air drives atmospheric convection cells.			

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SEASONS Concepts	NSES K - 4	NSES 5 - 8	NSES 9 - 12
17. Current weather conditions affect regional and global temperature patterns.	<i>Weather changes from day to day and over the seasons.</i>	Global patterns of atmospheric movement influence local weather.	Heating of the earth's surface and atmosphere by the sun drives convection within the atmosphere and oceans, producing winds and ocean currents.  Global climate is determined by energy transfer from the sun at and near the earth's surface. This energy transfer is influenced by dynamic processes such as cloud cover and the earth's rotation, and static conditions such as the position of mountain ranges and oceans.
18. Classification helps us organize and understand the natural world.	Objects can be categorized into two groups, natural and designed.		Biological classifications are based on how organisms are related. Organisms are classified into a hierarchy of groups and subgroups based on similarities which reflect their evolutionary relationships.
19. Models and simulations allow you to: study a process or phenomenon that would be difficult to study in other ways; compare the predicted values (using the model) and the measured values; modify input parameters in order to predict realistic changes in output.	<i>People have always had questions about their world. Science is one way of answering questions and explaining the natural world.</i>  <i>People have always had problems and invented tools and techniques (ways of doing something) to solve problems. Trying to determine the effects of solutions helps people avoid some new problems.</i>	<i>Technology is essential to science, because it provides instruments, and techniques that enable observations of objects and phenomena that are otherwise unobservable due to factors such as quantity, distance, location, size and speed. Technology also provides tools for investigations, inquiry and analysis.</i>	
20. A map is a symbolic representation of a certain land area.	<i>Tools help scientists make better observations, measurements, and equipment for investigations. They help scientists see, measure, and do things that they could not otherwise see, measure, and do.</i>		

## GLOBE Key Concepts LINKED to National Science Education Standards (NSES)

Primary links between GLOBE Key Concepts and NSES standards are indicated by non-italicized text; *secondary links are indicated by italicized text.*

GPS Concepts	NSES K - 4	NSES 5 - 8	NSES 9 - 12
1. A map is a symbolic representation of a certain land area; latitude and longitude are used to map locations.	<i>People have always had questions about their world. Science is one way of answering questions and explaining the natural world.</i>	<i>Technology is essential to science, because it provides instruments, and techniques that enable observations of objects and phenomena that are otherwise unobservable due to factors such as quantity, distance, location, size and speed. Technology also provides tools for investigations, inquiry and analysis.</i>	
2. Latitude and longitude can be measured indirectly using mathematical calculations that compare it to a nearby location whose latitude and longitude are known.			
3. The spatial relationship between Earth and celestial objects can be used to determine location on Earth; time & sun angle measurements can be used to determine the differences in latitude and longitude between two locations			
4. The Global Positioning System (GPS) consists of a series of satellites, their ground control stations and users with GPS receivers; GPS receivers measure latitude and longitude with an accuracy of 30 meters using angles measured in degrees and minutes.			
5. Levels of measurement include mathematical techniques to determine the degree of accuracy of the measurement.			
6. Speed of sound	<i>Sound is produced by vibrating objects.</i>		
7. Local time vs. Universal time			
8. Formation of shadows		Light interacts with matter by transmission (including refraction), absorptions, or scattering (including reflection).	
9. Magnetism, magnets and magnetic compasses; the Earth has a magnetic field; magnetic variations	Magnets attract and repel each other and certain kinds of other materials.		Electricity and magnetism are two aspects of a single electromagnetic force.
10. Sun – Earth seasonal relationships (solstice, equinox)	Objects in the sky have patterns of movement. The sun, for example, appears to move across the sky in the same way every day, but its path changes slowly over the seasons.	Most objects in the solar system are in regular and predictable motion. Those motions explain such phenomena as the day, the years ...	
11. Sun – Earth daily relationships	" "		
12. Relative and absolute direction	The position of an object can be described by locating it relative to another object or the background.		