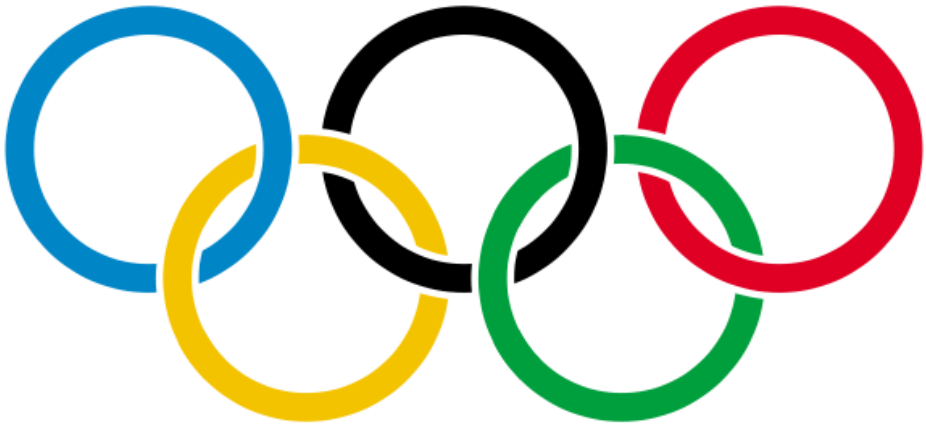
Your Guide to Surviving the 2014 STAAR Review Olympics!



*Your **personal** guide to the 2014 Hill Country Science STAAR Review*

Atoms

Student Expectation

The student is expected to describe the structure of atoms, including the masses, electrical charges, and locations, of protons and neutrons in the nucleus and electrons in the electron cloud.

Key Concepts

- **Key Concept 1:** An atom is the smallest unit of an element that upholds all of the properties of that element.
- **Key Concept 2:** Atoms are made up of subatomic particles called protons, neutrons, and electrons.
- **Key Concept 3:** Protons and neutrons are located in the nucleus of an atom and determine the mass of an atom.
- **Key Concept 4:** Protons have a positive electrical charge and electrons have a negative electrical charge. Atoms that have the same number of protons and electrons do not have an electrical charge.
- **Key Concept 5:** Electrons are located outside of the nucleus of an atom in the "electron cloud." They are smaller and have less mass than protons and neutrons.

Fundamental Questions

- What are subatomic particles, what are their charges, and where are they found?
- What is the nuclear model of the atom?
- What is the mass of an atom and how is that determined?
- How do atoms define (or determine) elements?

Protons and Electrons

Student Expectation

The student is expected to identify that protons determine an element's identity and valence electrons determine its chemical properties, including reactivity.

Key Concepts

- **Key Concept 1:** An element can be identified by its atomic number, or the number of protons located in its nucleus.
- **Key Concept 2:** Electrons are located outside of the nucleus and arranged by energy levels in the electron cloud. There are a certain number of electrons that each energy level can hold.
- **Key Concept 3:** Electrons located in the outermost shell of the electron cloud are called "valence electrons" and have the highest energy.
- **Key Concept 4:** Valence electrons determine the chemical properties of an element, or how the valence electrons of one element are shared or traded with valence electrons of other elements to create new molecules.
- **Key Concept 5:** The reactivity of an atom is how easily and readily its valence electrons interact with the valence electrons of other atoms. Atoms of metals have a tendency to transfer electrons to nonmetals when they react. Atoms of nonmetals have a tendency to gain or share electrons when they react.
- **Key Concept 6:** Atoms can gain or lose valence electrons, which change the electrical charge of the atom. Charged atoms are called ions.

Fundamental Questions

- How do protons determine an element's identity?
- How do valence electrons determine an element's chemical properties?

Periodic Table

Student Expectation

The student is expected to interpret the arrangement of the Periodic Table, including groups and periods, to explain how properties are used to classify elements.

Key Concepts

- **Key Concept 1:** Elements are arranged on the Periodic Table in increasing order of the atomic number or number of protons in the nucleus of the atom in an element.
- **Key Concept 2:** The atomic mass of each element increases when moving to the right and down the Periodic Table due to the addition of more atomic particles.
- **Key Concept 3:** Columns of elements are called groups and all elements in a group have the same number of valence electrons.
- **Key Concept 4:** Rows of atoms are called periods. When moving from left to right of a row, the number of valence electrons increases. When moving down the rows of the Periodic Table, the number of electron shells of the atom in each element increase.

Fundamental Questions

- How are elements arranged on the Periodic Table?
- What does the atomic number represent?
- What determines the atomic mass of an element?
- What do the columns on the Periodic Table represent, and how is the information used?
- What do the rows on the Periodic Table represent, and how is the information used?
- What physical and chemical properties are determined by investigating the Periodic Table?

Chemical Formulas and Equations

Student Expectation

The student is expected to recognize that chemical formulas are used to identify substances and determine the number of atoms of each element in chemical formulas containing subscripts AND recognize whether a chemical equation containing coefficients is balanced or not and how that relates to the Law of Conservation of Mass.

Key Concepts

- **Key Concept 1:** During a chemical reaction, the atoms of substances rearrange themselves into a new configuration forming new substances. The reactants (or the energy and atoms or molecules of the original substance) combine to produce products (or the energy, atoms, and molecules of the new substance).
- **Key Concept 2:** A chemical formula is the combination of all of the elemental symbols found within a substance. The atom numbers of each element are identified by subscripts to the right of the elemental symbol.
- **Key Concept 3:** A chemical equation shows the atom numbers and molecules making up the reactants and products of a chemical reaction. A number, or coefficient, in front of the molecule's chemical formula represents the molecule number in each reaction.
- **Key Concept 4:** Due to the Law of Conservation Mass, the total atom numbers of each element in a chemical equation is not changed during a chemical reaction; atoms are rearranged to form new compounds.
- **Key Concept 5:** A chemical equation is balanced when the reactants and products have the same number of each atom on each side in a chemical equation.

Fundamental Questions

- In a chemical reaction, how do the reactants recombine to form products?
- What is a chemical formula? What specific information does it illustrate?
- What is a chemical equation? What specific information does it illustrate?
- What does it mean to "balance" a chemical equation?
- What is the Law of Conservation Mass? How does this relate to a balanced chemical equation?

Chemical Reactions

Student Expectation

The student is expected to investigate how evidence of chemical reactions indicate that new substances with different properties are formed.

Key Concepts

- **Key Concept 1:** When a chemical reaction occurs new substances are formed that have different properties that the original substances.
- **Key Concept 2:** A chemical equation can be written to describe a chemical reaction. This equation has reactants and products.
- **Key Concept 3:** Chemical reactions can be classified into five different groups. Those groups are synthesis, decomposition, single replacement, double replacement and combustion.
- **Key Concept 4:** The four signs of a chemical reaction are formation of a gas, a production of heat or light, formation of a precipitate or a color change.
- **Key Concept 5:** If any of the signs of a chemical reaction are observed, then a chemical change has most likely occurred.

Fundamental Questions

- What defines a chemical reaction?
- What is a chemical equation?
- What are the reactants and products of a chemical equation?
- What are the four signs that indicate a chemical reaction has taken place?
- What are the five kinds of chemical reactions?

Unbalanced Forces

Student Expectation

The student is expected to demonstrate and calculate how unbalanced forces change the speed or direction of an object's motion.

Key Concepts

- **Key Concept 1:** There are always forces acting on objects, whether the objects are moving or are at rest.
- **Key Concept 2:** The total force on an object is called the net force and is calculated by adding the forces acting in the same direction and subtracting forces acting in the opposite direction.
- **Key Concept 3:** If the net force on an object is zero, the forces are balanced and the object stays still or in constant motion. If the net force is not zero the forces are unbalanced and the object's motion will change.
- **Key Concept 4:** Speed is the distance on object travels divided by the time it takes the object to travel that distance (s=d/t).
- **Key Concept 5:** When two forces act upon an object in opposite directions (horizontal and vertical), the net force is determined by calculating the difference of the forces. The object will move in the direction of the stronger force.
- **Key Concept 6:** When two or more forces act on an object in the same direction, the net force is determined by calculating the sum of the forces. The object will increase in speed and velocity as it moves in the direction of the net force.

Fundamental Questions

- How do interacting forces affect the speed of an object's motion?
- How do interacting forces affect the direction of an object's motion?
- How do different forces change an object's motion?

Speed, Velocity, and Acceleration

Student Expectation

The student is expected to differentiate between speed, velocity, and acceleration.

Key Concepts

- **Key Concept 1:** Motion can be defined as movement of an object, relative to some other point.
- **Key Concept 2:** Speed measures how quickly an object moves a certain distance, but does not factor in the direction of the movement.
- **Key Concept 3:** Velocity measures how quickly an object moves and the specific direction in which the object is moving.
- **Key Concept 4:** Acceleration measures how an object changes velocity by either moving faster, slower, or continuing to move at the same rate.

Fundamental Questions

- How can one differentiate between speed, velocity, and acceleration on a graph?
- How can one determine speed or velocity of an object given distance and time?
- How are speed, velocity, and acceleration represented on a distance vs. time graph?
- What is the difference between speed, velocity, and acceleration?

Laws of Force and Motion

Student Expectation

The student is expected to investigate and describe applications of Newton's law of inertia, law of force and acceleration, and law of action-reaction such as in vehicle restraints, sports activities, amusement park rides, Earth's tectonic activities, and rocket launches.

Key Concepts

- **Key Concept 1:** Newton’s law of inertia states that an object at rest stays at rest or an object in motion stays in motion until unbalanced forces act upon it.
- **Key Concept 2:** Newton’s law of force and acceleration states that the acceleration of an object depends on the object’s mass and magnitude of the force acting upon it (F=ma).
- **Key Concept 3:** Newton’s law of action-reaction states that for every action, there is an equal and opposite reaction.

Fundamental Questions

- How does the mass of a body at rest affect its tendency to remain at rest?
- How does the force required to move an object change with mass?
- How does the force acting on an object affect its tendency to remain at rest?

Rotation and Revolution

Student Expectation

The student is expected to model and illustrate how the tilted Earth rotates on its axis, causing day and night, and revolves around the Sun causing changes in seasons.

Key Concepts

- **Key Concept 1:** The axis is the center of rotation of Earth. Earth has a measurable tilt of 23.5 degrees on its axis.
- **Key Concept 2:** As Earth rotates on a 24-hour schedule, its east and west hemispheres alternate facing the Sun causing day and night.
- **Key Concept 3:** As Earth revolves around the Sun in its orbital path, it rotates on its axis and is tilted toward or leaning away from the Sun.This causes change in day length and to the angle of the sun's rays that strike the Earth's surface. Regions at different distances from the equator receive varied amounts of sunlight, resulting in the seasons experienced in the two hemispheres.

Fundamental Questions

- What is Earth's axis?
- What is the difference between Earth's rotation and revolution?
- What causes day and night?
- What causes the seasons?

Lunar Cycle

Student Expectation

The student is expected to demonstrate and predict the sequence of events in the lunar cycle.

Key Concepts

- **Key Concept 1:** The Sun illuminates the Moon's surface in a predictable pattern called the lunar cycle.

- **Key Concept 2:** The lunar cycle has 8 phases: waxing crescent, first quarter, waxing gibbous, full moon, waning gibbous, last quarter, waning crescent and new moon.
- **Key Concept 3:** Waxing is the process of the Moon appearing to "grow." Waning is the Moon appearing to "shrink."
- **Key Concept 4:** Quarter moons occur when only ¼ of the Moon is illuminated, appearing in the sky as a half circle.
- **Key Concept 5:** A full Moon occurs when half of the Moon's face is fully illuminated, appearing like a full circle. A new Moon occurs when no light from the Sun is reflected on on the half of the Moon visible to us on Earth.

Fundamental Questions

- What is the role of the Sun in the occurrence of the lunar cycle?
- What are the eight moon phases of the lunar cycle?
- What do the terms waxing and waning mean?
- What does the term a quarter moon mean?
- What is a meant by the terms a full moon and a new moon?

Ocean Tides

Student Expectation

The student is expected to relate the position of the Moon and Sun to their effect on ocean tides.

Key Concepts

- **Key Concept 1:** The Moon orbits Earth, and Earth orbits the Sun.
- **Key Concept 2:** As the Earth rotates on its axis, the Moon and Sun exert a gravitational pull on Earth.
- **Key Concept 3:** The Moon's gravity pulls on Earth's surface water, causing the water to rise and fall. The Sun's gravity also pulls on the Earth's surface water, causing a second, yet smaller, tidal effect. This creates a predictable schedule of high tides and low tides that coincide with the lunar cycle.
- **Key Concept 4:** The tides are most noticeable in large bodies of water, such as oceans, seas and large lakes. High tide is the greatest length inland a body of water reaches. Low tide is the lowest point on land a body of water recedes to.
- **Key Concept 5:** When the Sun and Moon are in alignment, as during a new or full Moon, the tide range is greatest. This is called a spring tide and is characterized by higher and lower tides. When the Sun and Moon are at right angles, as during a first quarter or last quarter Moon, the tidal range is lower. This is called a neap tide and is characterized by high and low tides that are different by only a few inches.

Fundamental Questions

- What is the spatial relationship of the sun, Earth, and moon?
- What affect does the gravitational pull of the moon and the sun have on Earth?
- What causes tides to occur on Earth?
- Why are we able to predict tides?
- What is a high tide? A low tide?
- What is a neap tide? A spring tide?

Components of the Universe

Student Expectation

The student is expected to describe components of the universe, including stars, nebulae, and galaxies, and use models such as the Herztsprung-Russell Diagram for classification.

Key Concepts

- **Key Concept 1:** A star is a large ball of gas that generates its own energy by fusing hydrogen atoms to make helium. It is held together by its own gravity. This process emits a tremendous amount of energy, and some of the energy is in the form of light. Stars come in a variety of sizes and compositions, which determine their amount of energy and gravity. The Herztsprung-Russell diagram is a scatter graph of stars, which shows the relative brightness levels and surface temperatures among the various types of stars.
- **Key Concept 2:** Hot clouds of gaseous elements and compounds called nebulae serve as nurseries for stars. As these nebulae spin, they slowly condense, raising their temperature and forming stars.
- **Key Concept 3:** Galaxies are made of millions of stars, interstellar gas, and dust that stay relatively close together due to gravity. The shape of a galaxy can be classified as elliptical, spiral, lenticular (lens-shaped) or irregular.
- **Key Concept 4:** Black holes are large objects that form dense gravity wells in space. Their gravitational pull is so strong that even light cannot escape it. They can be observed by the light and energy being given off by the objects they are pulling in. They are thought to be remnants of supernova explosions. They have zero volume but infinite density.

Fundamental Questions

- What are black holes, and how are they created?
- What are nebulae, and how are they important?
- How are stars different from each other?
- What is the Herztsprung-Russell Diagram, and how is it used to classify stars?
- How are galaxies classified?

The Sun

Student Expectation

The student is expected to recognize that the Sun is a medium-sized star near the edge of a disc-shaped galaxy of stars and that the Sun is many thousands of times closer to Earth than any other star.

Key Concepts

- **Key Concept 1:** The Sun is a medium-sized star relative to other stars and is located at the center of our solar system. Its position in the Milky Way galaxy is on the edge of a spiral, far away from the galactic center.
- **Key Concept 2:** Of the 50 stars closest to Earth, the Sun is the 4th largest in mass.
- **Key Concept 3:** The Sun is approximately 149.6 million kilometers away from Earth, which is the closest distance to Earth than any other star in the galaxy.
- **Key Concept 4:** It takes light an average of about 8.3 minutes to reach Earth's surface after leaving the Sun.

Fundamental Questions

- Where is our solar system located in the Milky Way galaxy?
- How does the Sun's mass compare with other stars in the galactic neighborhood?
- How does the distance of the Sun from Earth compare to the distances of other stars from Earth?
- How long does it take for light from the Sun to reach Earth's surface?

Electromagnetic Spectrum

Student Expectation

The student is expected to explore how different wavelengths of the electromagnetic spectrum such as light and radio waves are used to gain information about distances and properties of components in the universe.

Key Concepts

- **Key Concept 1:** The electromagnetic spectrum is a range of all types of electromagnetic radiation. The wavelengths range from very short wavelengths, including gamma and x-rays, to very long wavelengths, including microwaves and radio waves. Radiation is energy that travels and spreads through space. As the electromagnetic spectrum progresses from short wavelengths to long wavelengths, the relative energy of the waves decrease.
- **Key Concept 2:** Radio waves have long wavelengths with low energy and carry data over long distances. They are used in radios, televisions, cellular phones, and wireless networking. Radio waves are used to explore space, such as with radio telescopes.
- **Key Concept 3:** Microwaves have shorter wavelengths and more energy than radio waves. Recently, scientists have discovered background microwave radiation left over from the early formation of the universe. This gives us some idea about how far away other galaxies are from our galaxy.
- **Key Concept 4:** Light waves have shorter wavelengths than microwaves and provide us with the visible light spectrum – the colors that we see. Most stars emit energy in visible light waves. Since the speed of light is constant, you can measure how long it takes for light to reach an object and then calculate the distance it resides from that object.
- **Key Concept 5:** Gamma rays are potentially dangerous waves with extremely short wavelengths and very large amounts of energy. Solar flares and explosions of stars give off gamma rays. The radiation from gamma ray bursts can be lethal to living things. Information about black holes and subatomic particles in space is studied using gamma-ray telescopes.
- **Key Concept 6:** The electromagnetic spectrum (EMS) can be utilized to evaluate distant components of the universe to determine their movement relative to Earth's position and location.

Fundamental Questions

- What is the electromagnetic spectrum?
- How do pictures of objects taken in visible light compare with pictures of objects taken in other forms of radiation?
- How do astronomers use the EMS to gain information about the properties of the components of the universe?
- How do astronomers know that galaxies are moving away from Earth?

Light Years

Student Expectation

The student is expected to model and describe how light years are used to measure distances and sizes in the universe.

Key Concepts

- **Key Concept 1:** Light travels at 300,000 kilometers per second. This is known as the speed of light. It takes a ray of light about 8 minutes to go from the Sun to Earth.
- **Key Concept 2:** Because of the vast distances between stars and other objects in space, distances are measured in light years, which is the amount of distance light can travel in one Earth year, or 365 days. It is a measure of distance, not time.
- **Key Concept 3:** There is a time delay for images that are captured from objects in space because light takes time to travel. Depending on the distance of the object from the observer, by the time light enters through the lens of a telescope, it may have been traveling for years.

Fundamental Questions

- What is the speed of light and how far does it travel in one Earth year?
- How do astronomers measure distance?
- How long has light from other stars been traveling toward Earth?

Origins of the Universe

Student Expectation

The student is expected to research how scientific data are used as evidence to develop scientific theories to describe the origin of the universe.

Key Concepts

- **Key Concept 1:** Because light travels at a known speed, we can take snapshots of very distant wavelengths and determine the approximate age of the universe.
- **Key Concept 2:** Evidence about the age of the universe can also be gathered by studying how long certain known stars and other celestial objects took to form and by measuring the speed at which galaxies are moving away from one another.
- **Key Concept 3:** Scientists use a variety of methods to study the origins of the universe, such as telescopes and maps of microwave radiation left over from the Big Bang.
- **Key Concept 4:** The Big Bang is a theory that says the universe began as a very small and dense area that expanded rapidly. Data show that the universe is still expanding.
- **Key Concept 5:** Photographs taken of distant galaxies, using infrared light, give information about how and when the first objects in the universe formed.

Fundamental Questions

- How do astronomers use pictures of distance galaxies to determine the age of the universe?
- What does the formation of stars and other celestial objects tell us about the age of the universe?
- How do astronomers use the rate of universe expansion to determine the age of the universe?
- How do scientists use telescopes and microwave radiation to study the origins of the universe?
- What is the Big Bang Model of the origin of the universe?
- How do pictures taken, using infrared light, help astronomers study the origins of the universe?

Plate Tectonics

Student Expectation

The student is expected to describe the historical development of evidence that supports plate tectonic theory AND relate plate tectonics to the formation of crustal features.

Key Concepts

- **Key Concept 1:** In the early 20th century, Alfred Wegener developed early theories of continental drift, indicating that the continents of Earth move and historically were in different positions than they are currently.
- **Key Concept 2:** In the 1960s, scientific discoveries about seafloor spreading, combined with earlier theories of continental drift, led to a theory of plate tectonics.
- **Key Concept 3:** According to the theory of plate tectonics, Earth's lithosphere is made of plates that move and cause changes to crustal features at plate boundaries.
- **Key Concept 4:** Features on Earth's crust can be observed as consequences of plate tectonics. A convergent boundary occurs when two plates collide. Depending upon the type of crustal material at the boundary of the colliding plates, volcanoes, mountains and ocean trenches can form. A divergent boundary occurs when two plates move away from one another creating rift valleys in continental material and ridges in ocean basins. A transform boundary occurs as two plates move past each other causing faulting and earthquake activity.
- **Key Concept 5:** Mountain ranges, volcanoes, rift valleys and other land features can be observed from space, and these images can be used to support theories about tectonic plate activity.

Fundamental Questions

- What was the early theory of continental drift; who developed it, and when was it developed?
- What were the discoveries that led to a theory of plate tectonics, and when were these discoveries made?
- What is Earth's lithosphere made of, and how does it affect crustal features?
- What features of Earth's crust do convergent, divergent, and transform boundaries form?
- What land features formed by the movement of tectonic plates can be observed using images from space?

Erosional Features

Student Expectation

The student is expected to interpret topographic maps and satellite views to identify land and erosional features and predict how these features may be reshaped by weathering.

Key Concepts

- **Key Concept 1:** Topographic maps can be used to examine the elevation of an area. The elevation can be measured and monitored for changes over time.
- **Key Concept 2:** Satellite technology allows scientists to photograph land and erosional features and study them for changes over time.
- **Key Concept 3:** Evidence of changes that occurred in the past can be observed from space, allowing scientists to predict changes that might occur in the future due to sediment deposition, glacier movement, and river courses.

Fundamental Questions

- What is a topographic map? How is it used?
- How can a scientist study erosional changes in a landform over time?
- How can scientists predict changes caused by sediment deposition, glacier movement, and river courses?
- How can topographic maps and satellite views help scientists study landforms?

Sun's Energy

Student Expectation

The student is expected to recognize that the Sun provides the energy that drives convection within the atmosphere and oceans, producing winds and ocean currents.

Key Concepts

- **Key Concept 1:** The energy on Earth comes from the Sun, which heats up Earth's surface and all things on it. Matter that absorbs heat energy tends to rise, and matter that looses heat energy tends to fall. This constant churning of hot and cold is called convection.
- **Key Concept 2:** Wind is caused in part by the differences in thermal energy absorption at Earth's poles and equator. Warmer air has less pressure than cooler air. Differences in air pressure cause movement of air, which is wind. High pressure air pushes low pressure air.
- **Key Concept 3:** Ocean currents are driven by wind at the surface, but deeper currents are influenced by temperature and salinity differences. Warm water is less dense than cold water, and water with more salt is denser than ocean water with less salt.

Fundamental Questions

- What is the major source of thermal energy on Earth?
- What is convection?
- How is wind formed?
- How are ocean currents formed?

Weather Maps

Student Expectation

The student is expected to identify how global patterns of atmospheric movement influence local weather using weather maps that show high and low pressures and fronts.

Key Concepts

- **Key Concept 1:** Weather maps show weather systems, such as storms and fronts, over a large area and are used for predicting weather patterns in smaller regions like cities.
- **Key Concept 2:** Atmospheric conditions are predictable and can be tracked and measured over time by meteorologists.
- **Key Concept 3:** Air pressure is a measure of the weight of the air over a given area, as indicated by a barometer.
- **Key Concept 4:** Fronts occur in association with low pressure air masses where the air circulation causes the interaction between air masses with different temperatures and pressures. The front is the line of contact at ground level marking the boundary between the two air masses.
- **Key Concept 5:** A warm front is the leading edge of a warm, humid air mass, which rises into the atmosphere as it is pushed up by the surrounding, colder air. Warm fronts are represented by lines of red half circles on a weather map.
- **Key Concept 6:** A cold front is the leading edge of a cool, dry air mass moving into an area, displacing the warmer air, and contributing to storm formation. On a map, lines of blue triangles represent cold fronts.

Fundamental Questions

- What are weather maps, and what are the maps used for?
- How do meteorologists track, measure, and predict atmospheric conditions?
- What is air pressure, and how is it measured?
- What effect does a change in air pressure have on local weather conditions?
- Where do weather fronts occur?
- What is a warm front?
- What is a cold front?
- How are fronts depicted on a weather map?

Oceans and Weather

Student Expectation

The student is expected to identify the role of the oceans in the formation of weather systems such as hurricanes.

Key Concepts

- **Key Concept 1:** Ocean currents are important in regulating weather patterns around the globe.
- **Key Concept 2:** Weather is created by differences in temperature and moisture levels in a given area.
- **Key Concept 3:** As warm water moves into an area, it raises the humidity and temperature because more evaporation takes place.
- **Key Concept 4:** As cold water moves into an area, it can lower the temperature by absorbing more heat from the surrounding area, leading to colder and drier conditions on land.
- **Key Concept 5:** Hurricanes use warm, moist, tropical air as their fuel; they form when this air rises up from the ocean surface and creates a low-pressure system underneath. As the clouds form and rotate, they spin faster and are fed by the warm, evaporating water from the ocean's surface.

Fundamental Questions

- What is the role of ocean currents in regulating weather patterns around the globe?
- How is weather created in a given area?
- What is the effect of warm water moving into an area?
- What is the effect of cold water moving into an area?
- What causes a hurricane to form?

Relations in a Food Web

Student Expectation

The student is expected to describe producer/consumer, predator/prey, and parasite/host relationships as they occur in food webs within marine, freshwater, and terrestrial ecosystems.

Key Concepts

- **Key Concept 1:** Energy flows through various food chains as animals eat plants and predators consume prey, creating a food web. The energy that flows though food chains and food webs comes from the Sun.
- **Key Concept 2:** Trophic levels of organisms in a food web range from primary producers (autotrophs), and different levels of heterotrophs, including primary consumers (herbivores), secondary consumers (carnivores that eat herbivores), and tertiatry consumers (carnivores that eat carnivores).
- **Key Concept 3:** Other relationships in an ecosystem include predator/prey relationships and parasite/host relationships.
- **Key Concept 4:** Aquatic ecosystems include freshwater and marine biomes and constitute the largest part of the biosphere. In marine ecosystems, phytoplankton are autotrophic producers and are consumed by zooplankton and small invertebrates, which are consumed secondarily by fish and larger marine life.
- **Key Concept 5:** In terrestrial ecosystems, the primary producers are plants, which are consumed by insects, arthropods, and grazing animals. Secondary consumers include spiders, frogs, and carnivorous animals.

Fundamental Questions

- How does energy flow in a food chain and food web?
- Within a given food web, what are the primary producers (autotrophs) and heterotrophs, including the primary consumers, secondary consumers, and tertiatry consumers?
- What are examples of predator/prey relationships and parasite/host relationships found within a food web?
- What are examples of primary producers and primary and secondary consumers within a marine and freshwater food web?
- What are examples of primary producers and primary and secondary consumers within a terrestrial food web?

Interdependence

Student Expectation

The student is expected to investigate how organisms and populations in an ecosystem depend on and may compete for biotic and abiotic factors such as quantity of light, water, range of temperatures, or soil composition.

Key Concepts

- **Key Concept 1:** Resources for an organism's habitat, including space, food, shelter, and water, may be limited or depleted by competition. Two species cannot operate in the same niche in the same environment.
- **Key Concept 2:** Organisms rely on natural resources in their environment such as quantity of light, water supply, and suitable temperature.
- **Key Concept 3:** Competition occurs when niches overlap and organisms seek the same resources, especially when the population density is high.

Fundamental Questions

- How do organisms depend on abiotic and biotic factors to survive?
- What happens when two species in the same environment occupy the same niche?
- How are habitat resources affected by competition?

Environmental Changes

Student Expectation

The student is expected to explore how short- and long-term environmental changes affect organisms and traits in subsequent populations.

Key Concepts

- **Key Concept 1:** Changes in environmental conditions can affect the survival of individual organisms and entire species.
- **Key Concept 2:** Long-term environmental changes, like climate change, can permanently alter an ecosystem, but over time the change may cause some genetic variations to become more favorable or less favorable in the new environment. If adaptations to the new environment are not present or do not develop, populations can become extinct.
- **Key Concept 3:** Short-term environmental changes, like floods, don't give populations time to adapt to change and force them to move or become extinct.
- **Key Concept 4:** Human activity affects natural systems through agriculture, resource consumption, and pollution from waste disposal and energy production.

Fundamental Questions

- How are organisms and populations affected by human-induced environmental changes?
- How are organisms and populations affected by natural environmental changes?
- How do populations respond to long-term environmental changes?
- How do populations respond to short-term environmental changes?
- What is the difference between diversity and abundance?

Human Effect on Resources

Student Expectation

The student is expected to recognize human dependence on ocean systems and explain how human activities such as runoff, artificial reefs, or use of resources have modified these systems.

Key Concepts

- **Key Concepts 1:** Oceans are Earth's largest ecosystem. Ocean systems circulate energy and ocean temperatures regulate Earth's climate and weather.
- **Key Concept 2:** Marine algae produce oxygen and consume atmospheric carbon and play an important role in the cycling of matter for life on Earth.
- **Key Concept 3:** Human activity such as runoff pollution can originate from small or large sources on land and water, including motorized vehicles, oil spills, agricultural chemicals, and recreation. Runoff pollution negatively affects beaches and ocean habitats.
- **Key Concept 4:** Overharvesting food from the ocean creates an imbalance in existing ocean food webs. Other examples of the effects of human activity on oceans include climate change, spread of disease, and introduction of exotic species.

Fundamental Questions

- What ocean systems do humans depend on and how do they rely on these systems?
- How have human activities modified the ocean systems on which they depend?
- What are the consequences of human impact on ocean systems?