Ohio's Learning Standards for Science-Vertical Alignment of Content

To meet the goals of *Each Child, Our Future*, Ohio's strategic plan for education, schools and districts will find it essential to have appropriate local curricula supported by high-quality instructional materials. Science is part of providing well-rounded content for students – well-rounded content being one of the four learning domains listed in the strategic plan.

Ohio's Learning Standards and Model Curriculum for Science provides a logical progression of science content in each topic area that helps students build increasingly complex scientific understanding and reasoning based on a strong foundation. It is important that schools emphasize science instruction in the early grades to ensure students have enough experience to engage fully with science content at higher grade levels.

This document is just one example of how districts or teacher teams could organize content to promote discussions about vertical alignment and make sure they are teaching all content. They may need to adjust what is shown in this example to fit their local curricula. Districts or teacher teams also may find that a different breakdown of topics better meets their needs. Developing a local vertical alignment gives teachers a valuable opportunity to explore the standards and model curriculum in depth.

This document offers a broad view of how knowledge deepens over time in each topic area. This document can be used in a variety of ways. For an individual teacher, the vertical alignment can give a more detailed view of the existing skills and knowledge they can expect from students than the information shown in the *Prior Concepts* synopses for each standard. This may help teaches better understand the content students should have encountered before entering a grade. It also could inform teachers as they create pre-assessments to help identify missing prerequisite skills. Teachers meeting in vertical teams could use this framework to discuss the strengths of district instruction and plan for ways to address missing links in knowledge development for a given topic. For personnel such as curriculum directors, building administrators and instructional coaches, this document is a brief overview of the standards and model curriculum that can help identify gaps in the local curriculum.

This document is not a substitute for *Ohio's Learning Standards and Model Curriculum for Science.* It is essential that the full *Content Elaborations*, *Nature of Science*, *Science and Engineering Practices* and *Cognitive Demands,* including the sample *Visions into Practice,* be incorporated into instruction.

WEATHER, CLIMATE, SEASONS, ATMOSPHERE, HYDROSPHERE

Kindergarten	Grade 1	Grade 2	3	Grade 4
• Weather changes throughout the day and from day to day • Air is nonliving and surrounds Earth • Wind is moving air • Wind, temperature and precipitation are observed and measured (focus on comparisons rather than standard numeric units) • Seasons are identified based on patterns in weather observations	• The sun is the primary source of energy on Earth • The amount of exposure to sunlight affects the amount of warming or cooling of air, water and land • Seasonal changes impact the availability of resources • Students observe the effects of seasonal changes on local plants focusing on changes in temperature, liquid water, wind and light	• The atmosphere is primarily made up of air • Direction and speed of wind are measured with numeric values and compass direction • Instruments include wind socks, weather vanes, thermometers and simple anemometers • Weather events (hurricanes and tornadoes) are related to wind • Weather data is analyzed to look for patterns • Students relate conditions observed outside the classroom to weather • Students collect and document weather data, and analyze it to draw conclusions • Some forms of severe weather are regional • Scientists forecast severe weather events		• Ohio has experienced various climate patterns including glaciation and submersion under water

5	6	Grade 7	8
		• The hydrologic cycle is investigated in detail • Thermal energy transfers in the hydrologic cycle • Relationships between water, energy and weather are investigated • Porosity and permeability of soil and rock vary depending on composition • Groundwater and surface water quality as a component of the hydrologic cycle • Positive and negative effects of movement of water • Drainage patterns and watersheds • Thermal energy transfers in the ocean and atmosphere form currents • Global current and climate patterns • The influence of large bodies of water on weather and climate • Influences of thermal energy, density, pressure, composition and topography on currents in the atmosphere and ocean • The composition of the atmosphere • The atmosphere is held to Earth by gravity • Layers of the atmosphere as defined by temperature, chemical composition and physical characteristics.	

ASTRONOMY

Kindergarten	1	2	3	4
• The moon, sun and stars appear in different positions at different times • The sun is only visible during the day; the moon is visible at different times of day and/or night or may not be visible at all • The appearance of the moon changes throughout the month				

Grade 5	6	Grade 7	8
• The solar system includes the sun and all the bodies orbiting it • Each planet has a unique size, composition, movement and distance from the sun • Planets revolve in elliptical orbits • Some planets have moons • Comets, asteroids, dwarf planets and meteoroids also orbit the sun • Gravitational forces hold planets and moons in orbit • Asteroids are rocky bodies too small to be planets • Comets are mixtures of ices • Meteoroids become meteors in Earth's atmosphere and meteorites when they hit Earth's surface • Tools, technologies and recent astronomic projects/discoveries are explored • Students are introduced to the general scale of the solar system and universe • The sun is one of many stars in the universe • Stars are many sizes • The sun is only a medium sized star; it looks large because it is close to Earth • Which stars are visible and their apparent movement depends on the viewer's geographic location on Earth • Stars appear in patterns called constellations • Constellations can be used for navigation • Earth rotates on its axis which is tilted at 23.5° • Earth's rotation takes 24 hours and causes day and night • Earth's rotation causes the sun, stars and moon to appear to change position in the sky • Celestial objects appear to move east to west because of Earth's rotation • Day, night and changes in shadow length/direction are caused by Earth's rotation • Earth's revolution takes about 365 days • The constellations that are visible changes throughout the year due to Earth's revolution		• Causes of solar and lunar eclipses • Tides and the role of gravitational forces in the tidal cycle • Spring and neap tides and the orientations of Earth, moon, sun that cause them • The mechanisms that cause moon phases • The solar system as a part of the Milky Way galaxy • The relationship between Earth's axial tilt and angle of sunlight • The relationship between Earth's axial tilt and hours of daylight • Areas of Earth receiving direct and indirect radiation • The relationship between angle of sunlight and seasonal patterns • Causes of seasonal changes on Earth	

GEOLOGY

K	1	Grade 2	Grade 3	Grade 4
		• Fossils are preserved physical traces of past living things	• There is a difference between soil and dirt • Soil is composed of rock, organic material, water and air • Air and water are present in rocks and soil • Rocks are sorted and compared by observable characteristics (size/shape of grains, texture, color)	• Earth's surface can change due to weathering, erosion and deposition • Rocks change shape due to water and glacial movement, freeze and thaw, wind, plant growth, acid rain, pollution, flooding, earthquakes and volcanic activity • Different types of rock weather at different rates • Some weathering processes occur slowly; some occur quickly • Liquid water, wind and ice erode rock, soil and sediment • Gravitational force affects the movements of water, rock and soil • Weathering, erosion, deposition, flooding, volcanoes and earthquakes can create landforms • Common landforms are introduced (streams, deltas, floodplains, hills, mountains/mountain ranges, valleys, sinkholes, caves, canyons, glacial features, dunes, springs, volcanoes, islands) • Fossils provide a point of comparison between animals alive today and those that lived long ago • Fossils provide evidence that many species are extinct and that species have changed over time

5	Grade 6	7	Grade 8
	• Most rocks are composed of minerals (inorganic solids with a specific chemical composition) • The composition of rock (minerals and their size, shape and arrangement) can be used to identify the rock and interpret its history • Minerals have specific, quantifiable properties and form in specific environments • Some sedimentary rocks contain organic material (e.g., coal) • Minerals are identified by mineral tests for luster, hardness, cleavage, streak, magnetism, fluorescence and crystal shape • Rocks can be igneous, metamorphic or sedimentary • Rocks provide information about the environment in which they formed • Magma or lava cools and hardens to form igneous rock • Heat and pressure applied to existing rock forms metamorphic rock • Sedimentary rock forms when weathered material is compressed and lithifies • Ohio's geologic history and past environments is a focus of study • Soil is unconsolidated material that contains nutrient matter and weathered rock • Soil formation depends on environmental conditions, type of bedrock and rates of weathering • Properties are used to identify soil (texture, color, composition, permeability, porosity) • Soil sampling methodology and equipment are introduced • Soil horizons are observed and identified • Maps (soil, geologic, aerial, topographic) help identify soil formations • Rocks, minerals and soils have practical uses including construction, energy, transportation, agriculture, domestic use and technology. • The properties of the geologic resource determine its use • Resource management is introduced (extraction methods, use, storage, disposal, remediation) • Most geologic resources are nonrenewable		• Seismic waves are used to identify the composition and properties of Earth's interior • Earth has a core, a mantle and a crust • The physical and chemical layers of Earth are identified • Planetary differentiation • Sources of heat in Earth's interior • The history of the formation of Earth • Relationships among energy transfer, transformation and convection currents in Earth's interior • Earth's lithosphere consists of tectonic plates which move because of convection currents • Three main types of plate boundaries (transform, convergent, divergent) • Features and events that result from plate movement • Historical data leading to plate tectonic theory; modern data supporting plate tectonics • Constructive and destructive geologic process affect Earth's surface • Erosional and deposition events and surface features that influence them • Factors affecting streams and floodplains • Glacial features • Coastline and desert features • Uniformitarianism • Relative and absolute dating • Superposition • The geologic record is used to identify past environmental and climate conditions • Index fossils • Records from the cryosphere

THE ENVIRONMENT

K	Grade 1	Grade 2	Grade 3	Grade 4
	• Water is found in lakes, ponds, streams, wetlands, the ocean and the atmosphere • Earth has many different environmental conditions that vary in temperature, water, sunlight and available food sources • The environment includes living and nonliving things • Living things obtain materials from the environment to meet their basic needs • Seasonal changes impact the availability of resources • The amount and distribution of resources influence the types of organisms that can survive in an area	• The atmosphere is primarily made up of air • The water cycle is explored and discussed, focusing on evaporation and condensation (not steps, vocabulary or details) • Pollution and contamination can enter the waterways through precipitation, evaporation and condensation • Living things cause changes to their environments (limited to observable changes) • The environment is a combination of interactions between living and non-living components • Organisms become extinct when their needs are not met or the environment changes	• Energy resources can be renewable or non-renewable • Some of Earth's resources are limited • Resources can become limited due to overuse or contamination • Resources can be conserved by reducing use, decreasing waste and recycling or reusing • Some behavioral traits of living things are learned through interaction with the environment • Plants and animals have physical features that are associated with the environments where they live. • Plants and animals have certain adaptations that influence their chances of surviving in a particular environment	• 70% of Earth is covered by water • Freshwater is a small percentage of Earth's water • Freshwater is found in rivers, lakes ground water and glaciers • Ecosystems can change gradually or rapidly • Ecosystems are based on interrelationship among and between biotic and abiotic factors • Changes in ecosystems can be natural or human caused • When environments change, some plants and animals survive, others die or move • Liquid water, wind and ice physically remove and carry rock, soil and sediment (erosion) and deposit the material in a new location (deposition). • Changes in plant or animal populations can impact resources available to the remaining organisms • Ohio environments such as rivers, streams, meadows, bogs, lakes and moraines are used to explore changes that have occurred over time • Biodiversity exploration is expanded to include an increasing variety of living things including microscopic organisms

Grade 5	6	7	8
• Organisms perform various ecosystem roles • Food webs are used to identify relationships in an ecosystem • Producers convert light energy by photosynthesis • Consumers often form predator-prey relationships • Decomposers consume waste and dead organisms and return nutrients to the ecosystem • Some organisms form symbiotic relationships including mutualism, commensalism and parasitism • The environmental considerations of species loss, the introduction of new species and the effects of remediation programs are introduced • Direct and remote sensing can be used to obtain information about changes in ecosystems		• Matter and energy are continuously transferred between organisms and their physical environments • Energy transfer and transformation within and between ecosystems is explored • Photosynthesis and cellular respiration move energy through the environment • Plants make sugars from carbon dioxide and water, which can be used or stored for later use • Conservation of matter and energy are applied to ecosystems • Energy pyramids are used to illustrate energy flow • Some energy is dissipated to the environment as heat at each energy transfer in an ecosystem • Issues relating to new discoveries, technology and research are explored (biomass crops, alternative energy sources) • Biotic and abiotic factors affect the number, growth and survival of organisms or populations • Biomes are regional ecosystems with distinct types of organisms, soil and climatic conditions • Ecosystems are dynamic with the number and types of species fluctuating over time • Inadvertent or deliberate disruptions to components of an ecosystem impacts its composition • Biomes are defined by topography, soil types, precipitation, solar radiation and temperature • Various biomes are compared and linked to global climate patterns • Without limiting factors populations grow at rapid rates; limiting factors are explored • Succession in new or damaged environments is investigated	

CHARACTERISTICS OF LIVING THINGS

Kindergarten	Grade 1	Grade 2	Grade 3	Grade 4
• Living things are found worldwide • Living things grow • Living things reproduce • Living things respond to stimuli • Living things require energy, which plants get from the sun and animals get from food • Living things have physical traits and behaviors which influence their survival • Some traits are observable structures • Specific structures allow for specific activities	• Living things have basic survival needs that include temperature range, amount of water, and energy (amount of sunlight or available food sources) • Living things get the energy they need from the environment • Plants and animals require resources from their environments • Necessary habitat components include food, water, cover and space • Food sources include insects, plants, seeds and other animals • Cover is needed for nesting, escaping predators, shelter from the elements and resting • Space is needed for activities such as feeding and raising young • Plants need room to grow, an appropriate temperature range, light, water, air, nutrients and time to grow • Living things interact with their physical environment as they meet their needs	• All living things result from ancestors • Organisms become extinct when their needs are not met or the environment changes	• Organisms have different structures and behaviors that serve different functions • Plants and animals have physical features that are associated with the environments where they live • Some behavioral traits are learned through interaction with the environment • Plants and animals have life cycles • Students explore and investigate the life cycles of various organisms • Organisms are similar to their parents in appearance and behavior but show some variation	• Changes in an organism's environment are sometimes beneficial and sometimes harmful to its survival • Organisms can be classified according to similarities and differences based on internal and external structures • Non-Linnaean classification systems are developed based on gross anatomy, behavior patterns, and habitats

Grade 5	Grade 6	Grade 7	Grade 8
• All the processes that take place within organism require energy • Organisms can be classified by how they acquire energy • Plants and some microorganisms are producers • Producers perform photosynthesis to transform energy from the sun • Animals and decomposers obtain energy from other organisms	• Levels of organization (cells, tissues, organs, organ systems, organisms) • All living things are composed of cells • Many organisms are single-celled; others are multicellular • The function of cells is similar in all living organisms • Different tissues and organs are made of different types of cells • Cells, tissues and organs are viewed to identify similarities and differences • Cells in similar tissues and organs are similar • Plant tissues and organs differ slightly from animal tissue and organs • Cells contain specialized parts for various functions • Relationships between structure and function including cell organelles • Every cell is covered by a membrane that controls what enters and leaves • All cells come from pre-existing cells • Cell division is used from reproduction, growth and repair; mitosis is explored • Chromosomes are structures that contain genetic material; cells are observed dividing • Cells carry on functions (homeostasis, gas exchange, energy transfers/transformations, transportation of molecules, disposal of wastes and synthesis of new molecules) • Organisms have diverse body plans, symmetry and internal structures • Comparisons are made between organisms • Organisms are classified according to internal and external structures and processes • The link between cell size and ability to transport materials to the interior is explored	• Photosynthesis and cellular respiration are investigated as chemical processes	• Every organism comes from a long line of ancestors • Reproduction transfers genetic information from one generation to the next • Organisms can reproduce sexually or asexually • End products of mitosis and meiosis are compared • Asexual reproduction results in offspring identical to the parent • Sexual reproduction results in new combinations of traits which may increase or decrease chances of survival

HEREDITY AND EVOLUTION

K	1	Grade 2	Grade 3	Grade 4
		• Some ancestors of living things are extinct • Some fossils resemble things that are currently alive; others do not • Extinction is the disappearance of the last individual of a kind	• Students explore similarities and differences among individuals of the same type • Individual organisms inherit many traits from their parents • The immature stages of some organisms may not resemble the parent • Inherited traits may give an organism an advantage, a disadvantage, or have no effect on the ability to survive and reproduce • Organisms are similar to their parents but still show some variation	• Changes in an organism's environment are sometimes beneficial and sometimes harmful to its survival • Organisms can be classified according to similarities and differences based on internal and external structures • Non-Linnaean classification systems are developed based on gross anatomy, behavior patterns, and habitats

5	6	7	Grade 8
			• Diversification results from evolution and extinction • The fossil record documents change in number and types of species • Fossils provide evidence of changing environmental conditions • Transitional forms are introduced • Offspring can be similar to, yet different from parents as a result of sexual reproductions • Diversity in a species increases likelihood of survival of some individuals when the environment changes • Characteristics of an organism are inherited from the parent(s) • Traits are determined by DNA, which forms genes • Genes have different forms called alleles • Mendel's work and Mendel's two laws are investigated • Expression of traits is determined by genes and environmental factors • Dominant and recessive genes and codominant traits • Pedigree analysis • Phenotypes are expressed as a result of genotypes

MATTER

Kindergarten	Grade 1	Grade 2	Grade 3	Grade 4
• Objects are sorted and compared by properties such as color, size, shape, temperature, odor, texture and flexibility • Objects are made of materials such as clay, cloth, paper, metal and glass • Students make qualitative observations such as hot, warm cold, heavy, and light • Students make and compare quantitative observations with standard and non-standard tools	• The physical properties of water can change due to changes in energy • Water can change from a liquid to a solid and from a solid to a liquid. • Freezing and melting are investigated • Heating can change solids to liquids • Cooling can change liquids to solids • Measurements of weight, texture, temperature and size are compared before and after freezing • The amount of material remains constant during changes	• Air takes up space (has volume) • Air has mass • Water can exist as water vapor • Condensation and evaporation are explored experimentally and observationally	• Matter take up space and has mass • All solids, liquids and gases are made of matter • Mass is the amount of matter in an object • Volume is the amount of space matter occupies • Matter is composed of smaller parts, some too small to see • Matter continues to exist even when too tiny to see • Shape and compressibility distinguish state of matter • One way to cause a phase change is heating or cooling • Liquids and gases flow • Gases take the shape and volume of their containers • Liquids take the shape of the part of a container they occupy but retain their volume • Solids retain their shape and volume unless a force is applied • Substances other than water undergo phase changes	• The total amount of matter is conserved when objects break into pieces, solids dissolve in liquids or there is a change of state • Students collect experimental evidence that mass is conserved during macroscopic observable changes • When things are combined mass is always an additive property, but volume may not be • Some properties of matter stay the same even when other properties change (e.g., mass of water does not change even when physical state changes)

5	6	7	8
	• Matter is made of atoms • Matter has mass, volume and density • Mass and volume are measured • Mass versus volume graphs are made and interpreted • An element is defined • Atoms can join to form molecules • During phase changes atoms change their motion and position • Substances can exist as solids, liquids and gases • Solids, liquids and gases vary in the motion, spacing and attraction of particles • Gases are easily compressed • During phase changes temperature and mass remain constant	• Elements can be organized by properties • Properties of elements (color, solubility, hardness, density, conductivity, melting point, boiling point, viscosity, malleability) are used to categorize • Typical properties of metals, non-metal and metalloids are compared • All substances are composed of one or more elements • The number and types of atoms remain constant in a closed system • When new substances are formed mass is conserved • When new substances are formed, they may be very different from the original substances • Physically combining two or more substances forms a mixture • Elements are uniform and cannot be broken down by physical or chemical means • Elements, compounds, molecules and mixtures are defined and distinguished • Volume is not always conserved • Energy input is required to break a molecule • Energy is release when molecules are formed • In a chemical change the released energy may be either more or less than the original input energy.	

ENERGY

Kindergarten	Grade 1	Grade 2	Grade 3	Grade 4
• Sound is produced by touching, blowing or tapping objects • The same objects can make a variety of sounds • There is a connection between vibrations and sound energy • Concepts of pitch (low/high) and loudness are introduced	• The sun is the primary source of energy on Earth • The amount of exposure to sunlight affects the amount of warming or cooling of air, water and land • The physical properties of water and other materials can change due to changes in energy. • Plants get energy from sunlight; animals get energy from plants and other animals	• Weather is a result of energy change. • Energy changes (heating and cooling) can cause phase changes in water • Heating and cooling of water, air and land results in wind, evaporation, condensation, freezing, thawing and precipitation. • Weather data is connected to observable forms of energy (e.g., sailboat moving, hot sidewalk)	• Energy is the ability to cause motion or create change • Earth's resources can be used for energy • Specific energy sources in Ohio are introduced • Conservation of energy is explored • Heating may cause a solid to melt or a liquid to boil or evaporate • Cooling may change a gas to liquid or a liquid to a solid • Forms of energy include thermal energy, light, sound, electrical and magnetic energy	• Energy can be transferred and transformed • Energy transfers from hot objects to cold objects as heat, resulting in temperature change • The addition of heat may increase temperature; removal of heat may decrease temperature • Some materials conduct heat well; others do not • Electric circuits require a complete loop of conducting materials • Electricity flows easily in electrical conductors and poorly in electrical insulators (students test materials for conductivity) • Electrical energy in circuits can be transformed into other forms of energy including light, heat, sound and motion • Electricity and magnetism are related (explored experientially and observationally)

ENERGY (CONTINUED)

Grade 5	Grade 6	Grade 7	Grade 8
• All processes that take place within organisms require energy • Food webs are used to show energy flow in an ecosystem • Energy flows in ecosystems in one direction • Light and sound are forms of energy • Light travels faster than sound • Light can travel through empty space and some media • Some objects emit light • Light travels in a straight line • When light or sound hits an object it can be absorbed, reflected, or pass through • When light hits an object that it can't pass through, a shadow is formed • When objects absorb light, they warm • When light changes media is it often refracted • White light is a mixture of many colors (which can be seen with a prism) • Objects appear the color of the light they reflect • Sound requires a medium (solid, liquid or gas) to travel • Sound travels at different rates in different media • Pitch depends on vibration rate • Only a certain range of pitches is audible to humans	• Temperature is a measure of the average motion of particles • Thermal energy is the total kinetic energy of particle motion • Thermal energy depends on amount; temperature does not • Heat is a process of energy transfer and can result in a change of temperature or a phase change • During phase changes temperature and mass remain constant • There are two categories of energy, potential and kinetic • Kinetic energy is associated with motion • Potential energy depends on relative position	• Energy can be transformed or transferred but is never created or lost • A system is separated from its surroundings by a physical or mental barrier • Systems can be isolated or open; most systems on Earth are open • Energy transferred out of an open system may appear to be lost • Dissipated energy is energy that has transformed into thermal energy and been release into the surroundings • Dissipated energy is difficult or impossible to recapture and is usually no longer available for use • Energy changes in systems are explored virtually • Energy can be transferred in many ways • Mechanical energy is transferred when objects exert forces that moves one of the objects with or against the force • Waves transfer energy when they interact with matter • Waves are described by speed, wavelength, amplitude and frequency • Vibrations cause wave-like disturbances that transfer energy • Mechanical waves require a medium and can be transverse or longitudinal • Electromagnetic waves do not require a medium • Wave speed depends on the medium; waves travel at constant speed through a uniform material • Frequency of a wave is inversely related to wavelength • Real world wave data is investigated • Heat transfers from warmer objects to cooler objects • Thermal energy is transferred by conduction, convection and radiation • The factors affecting various types of potential energy are compared • Generators convert mechanical energy to electrical energy; motors do the opposite • Voltage is a measure of the electrical potential energy and depends on the energy source • An electric circuit consists of a closed loop(s) through which energy flows and is transformed • The relationship of current to resistance in simple series and parallel circuits are explored • Photosynthesis uses light energy to create carbohydrate molecules • Cellular respiration releases energy by breaking down molecules	• Thermal energy from Earth's mantle drives convection currents in the asthenosphere • Impacts during planetary formation generated primordial heat converting gravitational potential energy into kinetic and thermal energy

FORCES AND MOTION

K	Grade 1	Grade 2	3	Grade 4
	• The position of an object is described by comparing it to something • An object is in motion when its position is changing • Objects can move in a variety of ways • A force is a push or a pull • Pushing and pulling can affect motion by speeding an object up, slowing it down or changing its direction	• Forces are needed to change the motion of objects • Motion can increase, change direction or stop depending on the force • Larger forces cause larger changes in motion • Some forces act at a distance; some act when objects are touching • Gravitational, magnetic and static electric forces are explored through observation and investigation		• Gravitational force affects the movements of water, rock and soil

Grade 5	Grade 6	7	Grade 8
• Gravitational forces hold planets and moons in orbit • Gravitational forces continuously change the direction of orbiting objects • A force is described by its strength and direction • Any change in speed or direction of an object requires a force • Movement is a change in position • The movement of an object depends on its mass and the amount of force applied • Speed is a measure of how fast position changes • Speed can be calculated by dividing distance traveled by elapsed time • The combined effect of all the forces acting on an object affects its motion (consider only two forces, either horizontal or vertical, for this grade level) • When two forces are balanced motion does not change • When two forces are unbalanced motion changes (the focus for this grade is the effect on stationary objects)	• Motion is described by speed and direction • Position is graphed as a function of time • Position-time graphs are analyzed to determine relative motion • Speed can be found as a unit rate from a position-time graph		• Magnetic, electrical and gravitational fields exist around objects • Objects placed in a field may experience forces • All objects exert a gravitational force on all other objects • Gravitation force increases with mass and decreases with distance • Weight is a measure of the force of a gravitation field and is proportional to mass • Electrostatic fields may cause objects to attract or repel depending on the charges • Magnetic fields may cause objects to attract or repel • Electricity is related to magnetism • Electromagnets are investigated • Motion is measured compared to a reference point • Motion is dependent on the frame of reference of the viewer and may vary from different perspectives • Forces can be added • The net force on an object is the sum of all forces on the object and determines any change in motion • A net force of zero causes no change in motion • Force diagrams are interpreted and drawn • Friction is a force that opposes motion • Kinetic friction and drag are investigated