CONNECT-ED

Professional Development in Science and Mathematics

Big Idea Modules (BIMs) Available for Presentation

WHAT IS A BIG IDEA MODULE?
A BIM is a 6-hour learning experience that traces a Big Idea in science or mathematics across the elementary, middle, and high school grade levels, making concept and grade-level connections along the way. All BIMs have been designed and are presented by experienced teams of three teachers (one elementary, one middle school, and one high school), a district curriculum administrator, and a university/industry scientist or mathematician. The content strands indicated below are based on the AAAS *Atlas for Science Literacy* (science) or the New Jersey Core Content Curriculum Standards (math).

A BIM:

- Engages participants in using exemplary curricula to experience the big idea at the elementary, middle and high school levels
- Teaches science and mathematics content
- Models the inquiry approach to teaching and learning
- Makes connections: between grade levels; to other big ideas; and to other disciplines

BIMS are available in the following content areas: Chemistry, Physics/Astronomy, Earth Science, Life Science, and Mathematics.

For more information or to schedule a presentation in your district, please contact:
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Content Area	District	Title	Description
Chemistry	Hillsborough	Chemical Reactions: Reaction Rates I	• Many kinds of changes occur under hotter conditions. • The temperature and acidity of a solution influence reaction rates. • The rate of reaction among atoms and molecules depends on how often they encounter one another, which is affected by the concentration, pressure, and temperature of the reacting materials.
	Washington	Chemical Reactions: Reaction Rates II	• Objects can be described in terms of the materials they are made of and their physics properties. Things can be done to materials to change some of their properties, but not all materials respond in the same way to what is done to them. • When a new material is made by combining two or more materials, it has properties that are different from the original materials. • When substances interact to form new substances, the elements composing them combine in new ways. In such recombinations, the properties of the new combinations may be very different from those of the old.
	Newgrange	Atoms and Molecules: Invisibly Tiny Particles	• Most things are made of parts. • Materials may be composed of parts that are too small to be seen without magnification. • All matter is made up of atoms, which are far too small to see directly through a microscope.

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Chemistry (con't)	West Windsor Plainsboro	States of Matter	• Heating and Cooling cause changes in the properties of materials. • Most substances can exist as a solid, liquid, or gas depending on temperature. • In solids, the atoms or molecules are closely locked in position and can only vibrate. In liquids, they have higher energy, are more loosely connected, and can slide past one another; some molecules may get enough energy to escape into a gas. In gases, the atoms or molecules have still more energy and are free of one another except during occasional collisions. • An enormous variety of biological, chemical, and physical phenomena can be explained by changes in the arrangement and motion of atoms of molecules.
	Hopewell Valley	Chemical Reactions: Changing Properties I	• When a new material is made of combining 2 or more materials, it has propertied that are different from the original materials. • When substances interact to form new substances, the elements composing them combine in new ways. In such recombinations, the propertied of the new combinations may be very different from those of the old. • At atom's electron configuration, particularly the outermost electrons, determines how the atom can interact with other atoms. Atoms form ionic bonds to other atoms by transferring electrons from metals to non-metals.
	East Windsor	Chemical Reactions: Changing Properties II	• Things can be done to materials to change some of their properties, but not all materials respond the same way to what is done to them. • Many kinds of changes occur under hotter conditions. • The temperature and acidity of a solution influence reaction rates.
Physics/ Astronomy	Hillsborough	Gravity: Observations of the Sky	• The earth is one of several planets that orbit the sun, and the moon orbits around the earth. • The sun's gravitational pull holds the earth and other planets in their orbits, just as the planets' gravitational pull keeps their moons in orbit around them. • Gravitational force is an attraction between masses. The strength of the force is proportional to the masses and weakens rapidly with increasing distance between them.
	West Windsor-Plainsboro	Waves: Light and Scientific Record-Keeping	• Light travels and tends to maintain its direction of motion until it interacts with an object or material. Light can be absorbed, redirected, bounced back, or allowed to pass through. • Light from the sun is made up of a mixture of many different colors of light, even though to the eye the light looks almost white. Some things can be seen when light waves emitted or reflected by it enter the eye. Light act as a wave in many ways. Human eyes respond to only a narrow range of wavelengths of electromagnetic waves. • The observed wavelength of a wave depends upon the relative motion of the source and the observer.
	Lawrence	Waves: Vibrations	• Things that make sound vibrate. • Vibrations in materials set up wavelike disturbances that spread away from the source. Sound and earthquakes are examples. These and other waves move at different speeds in different materials. • Waves can superpose on one another, bend around corners, reflect off surfaces, be absorbed by materials they enter, and change direction when entering a new material. All of these effects vary with wavelength.

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Physics/ Astronomy (con/t)	Lawrence	Energy	• The way to change how something is moving is to give it a push or a pull. Things move in many different ways. • Changes in speed and direction are caused by forces. Energy is a property of many substances and is associated with heat, light, electricity, mechanical motion, sound, nuclei, and the nature of a chemical. Energy is transferred in many ways. • In most chemical and nuclear reactions, energy's transferred into or out of a system. Heat, light, mechanical motion, or electricity might all me involved in such transfers.
	Washington	Scientific Investigations: Kinds of Investigations	• Scientific investigations may take many different forms, including what things are like or what is happening somewhere, collecting specimens for analysis, doing experiments. • When similar investigations give different results, the scientific challenge is to judge whether the differences are trivial or significant, and it often takes further studies to decide. • Investigations are conducted for different reasons, including to explore new phenomena, to check on previous results, to test how well a theory predicts, and to compare theories.
	South Brunswick	Solar System: Observations of the Sky	• The rotation n the earth on its axis every 24 hours produces the night-and-day cycle. This turning if the planet makes it seem as though the sun, moon, and stars orbiting are around the earth on a day • Many chunks of rock orbit the sun. Those that meet the earth glow and disintegrate from friction as they plunge through the atmosphere-and sometimes impact the ground. • Our solar system coalesced out of a giant cloud of gas and debris left in the wake of exploding stars about five million years ago. Everything in and on the earth, including living organisms, is made of this material.
	East Windsor	Gravity: Forces and Motion and Proportional Reason: Kinds of Change and Related Changes	• The way to change how something is moving is to give it a push or a pull. • Change in speed or direction of motion are caused by forces. • An unbalanced force acting on an object changes its speed or direction, or both.
	Newgrange	Systems: Emergent Properties	• Make something out of paper, cardboard, wood, plastic, metal or existing objects that can actually be used to perform some task. • Inspect, disassemble, and reassemble simple mechanical devices and describe what the various parts are for; estimate the effect that making a change in one part of the system is likely to have on the system as a whole. • Troubleshoot some mechanical and electrical systems, checking for possible causes of malfunction, and decide on that basis whether to make a change…or get advice from an expert before proceeding.
	Trenton	A Scientific Inquiry Module (with Astronomy focus)	• Describing things accurately as possible is important in science because it enables people to compare their observations with those of others. • Scientific investigations usually involve the collection of relevant evidence, the use of logical reasoning, and the application of imagination in devising hypotheses and explanations to make sense of the collected evidence. • Hypotheses are widely used in science for choosing what data to pay attention to and what additional data to seek, and for guiding the interpretation of the data.

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Math	Trenton	2-D and 3-D Math	• Determine the perimeter of simple shapes by measuring all the sides. Determine the area of 2-dimensional shapes on a square grid. • Distinguish between perimeter and area and use each appropriately in problem solving situations. Develop and apply strategies and formulas for finding the surface area and volume of rectangular prisms and cylinders. • Develop and apply strategies and formula for finding the surface area and volume of a 3-dimensional figure.
	Hillsborough	Understanding Data in the World Around Us	• Data Analysis, Probability and Discrete Math (Data Analysis or Statistics) • Data Analysis, Probability and Discrete Math (Probability) • Number and Numerical Operations (Estimation)
	Montgomery	Applying Math to Chance	• Demonstrate understanding of whole number place value. Count and perform simple operations with coins. • Analyze functional relationships to explain how a change in one quantity can result in a change in another, using pictures, graphs, charts, and equations. Using patterns are relations, symbolic algebra, and linear functions to model situations. • Estimate probabilities and make predictions based one experimental and theoretical probabilities.
	South Brunswick	Data Analysis, Probability, and Discrete Math	• Determine probabilities of simple events based on equally likely outcomes and express them as fractions. • Explore compound events • Estimate probabilities and make predictions based one experimental and theoretical probabilities.
	Washington	Data Analysis Through Real World Application	• Read, interpret, construct, analyze, generate questions about, and draw inferences from displays of data. • Select and use appropriate representation for sets of data, and measure of central tendency (mean, median, mode). Estimate lines of best fit and use them to interpolate within the range of data. • Evaluate the use of data in real-world contexts.
	West Windsor-Plainsboro	Perfections and Discrepancies: Building and Analyzing Mathematical Models	• Recognize, describe, extend, and create patterns. • Graph functions and understand and describe their general behavior. Using patterns, relations, symbolic algebra, and linear functions to model situations. • Analyze and explain the general properties and behavior function of one variable, using appropriate graphing technologies. Develop and informal notion of limit.
Earth Science	Burlington City	Processes That Shape the Earth: Changes in the Earth's Surface	• Waves, wind, water, and ice shape and reshape the earth's land surface by eroding rock and soil in some areas and depositing them in other areas, sometimes in season layers. • The interior of the earth is hot. Heat flow and movement of material within the earth cause earthquakes and volcanic eruptions and create mountains and ocean basins. • Earthquakes often occur along the boundaries between colliding plates, and molten rock from below create pressure that is released by volcanic eruptions, helping to build mountains. Under ocean basins, molten rock may well up between separating plates to create new ocean floor. Volcanic activity along the ocean floor may form undersea mountains, which can thrust above the ocean's surface to become islands.

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Earth Science (con't)	Ewing	Alternative Energy	• People burn fuels such as wood, oil, coal or natural gas, or use electricity, to cook their food and warm their houses. • Energy from the sun (and the wind and water energy derived from it) is available indefinitely. Because the transfer of energy from these resources is weak variable, systems are needed to collect and concentrate the energy. • The earth has many natural resources of great importance to human life. Some are renewable, some are renewable only at a great cost, and some are not renewable at all.
	Hamilton	It's Not Easy Being Green	• Human beings have made tools and machines to sense and do things that they could not otherwise sense or do at all, or as quickly, or as well. • Engineers, architects, and others who engage in design and technology use scientific knowledge to solve practical problems. But they usually have to take human values and limitations into account as well. • Technological problems often create a demand for new scientific knowledge and new technologies make it possible for scientists to extend their research in new ways or to undertake entirely new lines of research. The very availability of new technology itself often sparks scientific advances.
	Hillsborough	Earth on the Move	• Waves, wind, water and ice shape and reshape the earth's land surface by eroding rock and soil in some areas and depositing them in other areas, sometimes in seasonal layers. • Some changes in the earth's surface are abrupt (such as earthquakes and volcanic eruptions) while other changes happen very slowly (such as uplift and wearing down mountains. • Earthquakes often occur along boundaries between colliding plates, and molten rock from below creates pressure that is released by volcanic eruptions, helping to build up mountains. Under the oceans basins, molten rock may well up between separating plates to create new ocean floor. Volcanic activity along the ocean floor may form undersea mountains, which can thrust above the ocean's surface to become islands.
	Lawrence	Winds and Hurricanes	• When warmer things are put with cooler ones, heat is transferred from the warmer one to the cooler ones. • Heat is transferred through materials by collisions of atoms across space by electromagnetic waves. If the material is fluid, currents will be set up in it that aid the transfer of energy. • Transfer of heat energy at the interfaces of the atmosphere with the land and oceans produces layers at different temp in both the air and the oceans. These layers rise or sink or mix, giving rise to winds and ocean currents that carry heat energy between warm and cool regions. The earth's rotation curves the flow of winds and ocean currents, which are further deflected by the shape of the land.
	Newgrange	Human Impacts on Living Environments	• When liquid water disappears, it turns into a gas (vapor) in the air and can reappear as a liquid when cooled, or as a solid if cooled below the freezing point of water. Clouds and fog are made of tiny droplets of water. • The cycling of water in and out of the atmosphere plays an important role in determining climatic patterns. Water evaporates from the surface of the earth, rises and cools, condenses into rain or snow and falls again to the surface. The water falling on land collects in rivers and lakes, soils and porous layers of rock and much of it flows back into the oceans.

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Earth Science (con't)			• Human beings are part of the earth's ecosystems. Human activities can deliberately or inadvertently, alter the equilibrium in ecosystems.
	South Brunswick	Weather and Climate	• Change is something that happens to many things • Human activities, such as reducing the amount of forest cover, increasing the amount and variety of chemicals released into the atmosphere, and intensive farming, have changed the earth's land, oceans, and atmosphere. Some of these changes have decreased the capacity of the environment to support some life forms. • The earth's climate have changed in the past, are currently changing and are expected to change in the future, primarily due to changes in the amount of light reaching places on the earth and the composition of the atmosphere. The burning of fossil fuels in the last century has increased the amount of greenhouse gases in the atmosphere, which has contributed to earth's warming.
	West Windsor-Plainsboro	Trapping Heat: What the dragon, the panther, and the pirate have in common.	• Some materials conduct heat much better than others. Poor conductors can reduce transfer of heat from warmer to cooler objects. • Energy transformations usually produce some energy in the form of thermal energy which spreads around by radiation or conduction into cooler places. • Depletion of the energy sources can be slowed by use of designs that limit the production of unwanted forms of energy and by use of insulation to restrict unwanted transfers of energy based on SFAA.
	Robbinsville	Understanding Change	• Things change in steady, repetitive, or irregular ways-or sometimes in more than one way at the same time. • Some changes in the earth's surface are abrupt (such as earthquakes and volcanic eruptions) while other changes happen very slowly (such as uplift and wearing down mountains. • Earthquakes often occur along the boundaries between colliding plates, and molten rock from below create pressure that is released by volcanic eruptions, helping to build mountains. Under ocean basins, molten rock may well up between separating plates to create new ocean floor. Volcanic activity along the ocean floor may form undersea mountains, which can thrust above the ocean's surface to become islands.
Life Science	Hamilton	Survivor	• Some likenesses between children and parents are inherited. Other likenesses are learned. • Small differences between parent and offspring can accumulate (through Selective breeding) in successive generations so that descendents are very different from their ancestors. • The continuing operation of Natural Selection on new characteristics and in changing environments, over and over again for millions of years, has produced a succession of diverse new species.
	Hillsborough Team 2	Making Sense of Diversity	• A great variety of kinds of living things can be sorted into groups in many ways using various features to decide which things belong to which group. • In classifying organism, scientists consider details of both internal and external structures. • A classification system is a framework created by scientists for describing the vast diversity of organism, indicating the degree of relatedness between organisms, and framing research questions.

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Life Science (con't)	Newgrange	Who Are You?	• People have different external features, such as the size, shape, and color of hair, skin, and eyes, but they are more like one another than like other animals. • In organisms that have sexes, typically half the genes come from each parent. • The information passed from parents to offspring is coded in DNA molecules.
	West Windsor-Plainsboro	Humans Are Disturbing	• For any particular environment, some kinds of plants and animals thrive, some do not live as well, and some do not survive at all. • Changes in environmental conditions can affect the survival of individual organisms and entire species. • The human species has a major impact on other species in many ways: reducing the amount of the earth's surface available to those other species, interfering with their food sources, changing the temperature and chemical composition of their habitats, introducing foreign species into their ecosystems, and altering organisms directly through selective breeding and genetic engineering.
	Burlington City	Family Ties	• Offspring are very much, but not exactly like their parents and like one another. • In organisms, that have sexes, typically half of the genes come from each parent. • New heritable characteristics can result from new combinations of existing genes or from mutations of genes, in reproductive cells.
	Lawrence	Staying Alive	• Diseases caused by germs may be spread by people who have them. Washing one's hands with soap and water reduces the number of germs that can get into the body or that can be passed on to other people • Vaccines induce the body to build immunity to a disease without actually causing that disease. • The immune system is designed to protect against microscopic organisms and foreign substances that enter from the outside the body and against some cancer cells that arise.
	Montgomery	Flow of Matter in Ecosystems	• Animals eat plants or other animals for food. • Almost all kinds of animals' food can be traced back to plants. Insects and various other organisms depend on dead plant and animal material for food. • All organisms, including the human species, are part of and depend on two main interconnected global food webs. One includes microscopic ocean plants, the animals that feed on them, and finally the animals that feed on those animals. The other web includes land plants, the animals that feed on them, and so forth.

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SELECT
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