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ABSTRACT

Balancing limited time and effort between knowledge that students should know in depth (intensive curriculum) and knowledge about which they should have some understanding (extensive curriculum) poses a challenge for many educators. One solution to this problem involves the use of the connecting idea. A connecting idea links content that is part of the intensive curriculum to content identified as part of the extensive curriculum. It is a short, descriptive phrase that is explained more fully to make the link clear. It is intended to provide a means for familiarizing students with concepts that might not otherwise be introduced, given the limited time available for schooling. The link helps to create relevance in the extended content by connecting it with essential content learning material in a meaningful way. The connecting idea makes clear the links among disciplines and yet does not require extensive planning or particular subject-area expertise on the part of the teacher. Fourteen samples linking science facts with historical developments illustrate the method in a concrete way. (Contains 13 references.) (RT)

CONNECTING IDEAS: A STRATEGY FOR EXTENDING THE CURRICULUM

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INTRODUCTION

The Problem

It has been observed that all of the knowledge and skills identified as important by national organizations in the subject areas cannot be addressed in the classroom given the time available in the school day. Education researcher Chester Finn, for example, reviewing documents produced by many standards-setting groups, said that "the professional associations, without exception, lacked discipline. They all demonstrated gluttonous and imperialistic tendencies" (in Diegmueller, 1995, p. 6).

A closely related concern appears in the report of the Third International Mathematics and Science Study (TIMSS), a large-scale, cross-national comparative study of math and science curricula. In addressing the relatively poor performance of U.S. students, the report's authors note that our "preoccupation with breadth rather than depth, with quantity rather than quality, probably affects how well U.S. students perform in relation to their counterparts in other countries" (Schmidt, McKnight, & Raizen, 1997). Addressing all content at an appropriate level of quality and depth is simply not possible. Researchers Marzano and Kendall (1999) show that at least by one measure, attempting to address all the content identified in standards documents would mean that "schooling would have to be extended from kindergarten to grade 21" (p. 104).

The Intensive and Extensive Curriculum

One solution to the problem of too little time for the content identified was proposed by E.D. Hirsch, who developed the idea of the intensive and extensive curricula. Hirsch introduced this idea in *Cultural Literacy: What Every American Needs to Know* (1987). As defined by Hirsch, the extensive curriculum comprises knowledge about which all students should have some understanding; the intensive curriculum comprises what students should know in depth. The content individual students will study in depth may vary, but through the addition of the extensive curriculum, all students should have at least a passing familiarity with all content identified in the complete curriculum. Hirsch described the difference between the intensive and extensive curriculum in the following way:

> The conception of a two-part curriculum avoids the idea that all children should study identical materials. It also resists the lure of a core curriculum, if that proposal is taken to mean that all high school graduates should study, say, *Romeo and Juliet*. A common extensive curriculum would ensure that students have some information about *Romeo and Juliet*, but in their intensive curriculum they might study *The Tempest* or *Twelfth Night* in detail. If a school decided that all its students should read two Shakespeare plays in depth, even the most convinced traditionalists would find it hard to agree on which two plays they should be. Schools can find means of imparting extensive information side by side with an approach that conveys intensive knowledge as well, without imposing an arbitrary core curriculum. (p. 128)

As the basis of his curriculum, Hirsch proposed the knowledge identified in his book *Cultural Literacy.* The knowledge that would *not* be intensively studied, the extensive curriculum, would be imparted to students through vocabulary instruction. Researchers Marzano and Kendall (1999) endorsed Hirsch's concept of the two-part curriculum as a strategy for addressing the problem of too much content. They also agreed with Hirsch's recommendation that vocabulary instruction was an effective means for imparting that portion of the curriculum that was not to be taught in depth. They argued, however, that the database of content from which Hirsch drew the curriculum was significantly flawed (for a complete discussion, see Marzano & Kendall, 1999, pp. 36–58). They proposed instead that the terms and phrases that form the vocabulary list be developed from a database with a sound research basis. They provided a list of such vocabulary terms developed from *Content Knowledge: A Compendium of Standards and Benchmarks for K–12 Education* (Kendall & Marzano, 1997), which synthesizes student knowledge and skill identified across 137 significant standards documents.

A Different Approach: The Connecting Idea

This study presents an additional strategy — the *connecting idea* — for addressing the academic content that may be directly taught and assessed. In this approach, the connecting idea is a means, like vocabulary instruction, for addressing the extensive curriculum. The purpose of a connecting idea is to introduce the extensive curriculum in a meaningful way. A connecting idea links content that is part of the intensive curriculum to content identified as part of the extensive curriculum. For ease of discussion, we term the content that forms part of the intensive curriculum the *essential content*, and the content that forms part of the extensive curriculum the *extended content*. The connecting idea is a short, descriptive phrase, but each connecting idea is explicated more fully in order to make the link clear. Consider, for example, Exhibit 1. The essential content is a specific benchmark (sometimes called an objective) under a general science standard regarding the structure and properties of matter. The essential standard and its benchmark are followed by a suggested connecting idea, an explication of the link, then the specific benchmark of extended content that the topic joins.

In this example, the concept of oxidation of metals is the focus of instruction. Information specific to the Copper and Bronze Ages is not central to understanding this idea, but the connection to history helps make clear for students how such a process has affected history. More broadly, students could come to understand how the facts of science connect to everyday lives. The connecting idea focuses primarily on science knowledge. The link does not require that the teacher be well versed in prehistory.

The use of the connecting idea has an advantage over vocabulary instruction in familiarizing students with the extensive curriculum. Because the extended content is introduced in the context of related and meaningful content, the information is more likely to be remembered than if isolated vocabulary terms are presented. Meaningfulness and context are widely known to enhance one's memory of information (Anderson, 1990). In this respect, connecting ideas share the advantages of a number of other approaches that seek to use topics to broaden and deepen students' connections to new information (Erickson, 1998; Jacobs, 1989). A connecting idea

ESSENTIAL CONTENT

SCIENCE
Standard: Understands the structure and properties of matter
Benchmark: Knows that oxidation involves the combining of oxygen with another substance (e.g., burning, rusting)

CONNECTING IDEA: WORKING WITH METALS
Civilizations are often identified by the technology they used. Ancient people entered the Copper Age once they discovered that when this mineral was heated it could be formed into metal ornaments and tools. During the process of oxidation it became softer, or more malleable. Later, they discovered that smelting tin with the copper produced a much stronger metal, one that could be used for tools and weapons; this advance, the Age of Bronze, was named after the alloy they created.

EXTENDED CONTENT

SOCIAL STUDIES – WORLD HISTORY
Standard: Understands major trends in Eurasia and Africa from 4000 to 1000 BCE
Benchmark: Knows the fundamental inventions, discoveries, techniques, and institutions that appeared from 4000 to 1000 BCE, and understands the significance of bronze technology for economic, cultural, and political life

shows how new information can be applied to other subject areas and experiences outside the immediate lesson or unit.

The connecting idea shares similarities with a number of designs that seek to enhance meaning through an interdisciplinary approach. Commonly, such designs use either an integrating theme as a framework for unit planning, or a broadly stated topic for joining ideas from different disciplines. It is usually the case that these designs anticipate that each subject area will dedicate a significant portion of time to a common topic, addressed at an appropriate level of detail. Although such an approach provides a number of benefits, it also creates potential difficulties, especially at levels above upper elementary. If the content is to be addressed from the view of numerous subject areas, then some coordination of lesson plans and teaching schedules is required. Otherwise, teachers would be required to address all content themselves, requiring them to teach outside their area of expertise. When using a connecting idea, such problems do not arise. First, the connecting idea presents material in such a way that expertise in the subject area of the extended content is unnecessary. Second, the extended content itself will not always be assessed, so there is no demand that every student understand the extensive curriculum content to the level that he or she could demonstrate understanding of the material. In this respect, the connecting idea is similar to designs that include what some call *curriculum*

enrichment, or what Wiggins & McTighe (1998) call "knowledge that students should find *worth being familiar with*" (p. 9) (italics, the authors').

The connecting idea does share other similarities with integrative designs. Connecting ideas always are developed "upwards" from, and hence connected directly to, specific benchmarks or objectives. Some approaches to integration provide for the development of themes directly from identified objectives (Foriska, 1998; Lonnning, DeFranco, & Weinland, 1998). Many more approaches begin from "universal concepts," or "generative topics," looking for subtopics or "understanding goals" that might be appropriate. (Gamberg, Kwak, Hutchings, & Altheim, 1988; Perkins & Blythe, 1994). The connecting idea is developed from examining the specific content that will be taught.

As is likely clear, the connecting idea does not integrate activities, lesson plans, or units. It should, however, be easily included within any existing activity, lesson plan, or unit that incorporates the essential content for which the link has been developed.

Criteria for Development

A connecting idea should meet certain criteria to ensure that it serves its intended purpose. A connecting idea can be constructed for any kind of content — essential or nonessential. However, it is of little benefit in introducing extended content if the connecting idea is not linked to content that is essential — that is, content that will certainly be covered.

The extended content, on the other hand, should not be essential. It should not be commonly assessed or considered a critical part of the curriculum. If the extended content is explicitly addressed in another course, the linking topic does not serve the goal of familiarizing students with content that they will otherwise not be exposed to.

Finally, the connecting idea itself, and the description that elucidates it, should form a natural connection between the essential and extended content. In the next section we describe a process used for making this connection.

The Process

To determine the feasibility of linking essential and extended content through connecting ideas, the authors undertook to develop a set of such topics. The work was focused on a particular range of grades and subject areas. The grade range selected was middle school, or grades 6 through 8. For the essential content — that is, what forms the intensive curriculum — the subject area of science was chosen. The continued and growing emphasis on science and assessment of science content suggests that much within this subject might be considered essential content. To increase the likelihood that the content selected for topic development would be considered important by most schools, the science content was selected by consulting a 1999 McREL study (Kendall, Snyder, Schintgen, Wahlquist, & Marzano). That study identified science content commonly found in states' standards documents that were highly valued for the quality of their standards.

For the part of the topic that incorporates extended content, the subject area of history was selected, for a number of reasons. History encompasses such a vast amount of material that much of it, at least in terms of the facts, events, and episodes it comprises, cannot be addressed given the time available for schooling. In addition, in the authors' experience, there are increasing reports of concern that the social studies, and history in particular, are allotted a diminishing amount of instructional time as high-stakes testing turns districts' interest to literacy, mathematics, and science. Thus, it appeared that social studies, and history in particular, might benefit from the use of connecting ideas. History or the social studies, of course, should not be relegated to the status of non-essential content. The selection of history for extended content simply recognizes certain facts about the nature of the discipline and the current state of the curriculum in a number of districts.

The result of this process is a set of 13 connecting ideas, provided in the pages that follow. For both essential and extended content, the source of standards and benchmarks was McREL's database of standards (Kendall & Marzano, 1997). All essential content is from science; all extended content is history. On some occasions, additional extended content was developed for geography, when the fit seemed appropriate.

Summary

The connecting idea is intended to provide a means for familiarizing students with concepts that might not otherwise be introduced, given the limited time available for schooling. The connecting idea makes clear the links among disciplines but does not require extensive planning or particular subject-area expertise on the part of the teacher.

SAMPLE CONNECTING IDEAS

ESSENTIAL CONTENT

SCIENCE
Standard: Understands atmospheric processes and the water cycle
Benchmark: Knows that the Sun is the principal energy source for phenomena on the Earth's surface (e.g., winds, ocean currents, the water cycle, plant growth)

CONNECTING IDEA: WIND CURRENTS/TRADE WINDS

The energy of the sun is the principal source of wind. Wind currents are caused by a number of factors, including temperature differences, density differences, and the spin of the planet. Explorers found that some currents — prevailing wind currents — were predictable. Prevailing wind currents had an impact on trade routes, because they affected both the speed and general direction of travel.

EXTENDED CONTENT

SOCIAL STUDIES – WORLD HISTORY
Standard: Understands how the transoceanic interlinking of all major regions of the world between 1450 and 1600 led to global transformations
Benchmark: Understands what contributed to increasing oceanic travel in the 15th and 16th centuries (e.g., major Spanish and Portuguese technological innovations in shipbuilding, navigation, and naval warfare; navigational inventions such as the compass, astrolabe, and quadrant; trade routes of prominent Asian and European explorers and how prevailing wind currents influenced these routes; the features of Chinese and Arab sailing vessels that made long-distance travel easier)

ESSENTIAL CONTENT

SCIENCE

Standard: Understands atmospheric processes and the water cycle

Benchmark: Knows factors that can impact the Earth's climate (e.g., changes in the composition of the atmosphere; changes in ocean temperature; geological shifts such as meteor impacts, the advance or retreat of glaciers, or a series of volcanic eruptions)

CONNECTING IDEA: THE ICE AGE

An ice age is a naturally occurring phase on Earth that includes cold climatic temperatures and glaciers that can cover large regions of the Earth. Theories of what may cause an ice age include how far the Earth is from the sun, changes in ocean circulation, and changes in the composition of the atmosphere. The Ice Age had a significant impact on plant life and thus upon the migration of the animals and humans who depended upon vegetation.

EXTENDED CONTENT

SOCIAL STUDIES – WORLD HISTORY

Standard: Understands the biological and cultural processes that shaped the earliest human communities

Benchmark: Understands the role of the environment in the development of different human communities (e.g., current and past theories regarding the emergence of Homo sapiens and the processes by which human groups populated the major world regions; how environmental conditions in the last Ice Age possibly affected changes in the economy, culture, and organization of human communities)

ESSENTIAL CONTENT

SCIENCE
Standard: Understands Earth's composition and structure
Benchmark: Knows components of soil and other factors that influence soil texture, fertility, and resistance to erosion (e.g., plant roots and debris, bacteria, fungi, worms, rodents)

CONNECTING IDEA: THE FERTILE CRESCENT

As the name suggests, the Fertile Crescent refers to an area of rich soil. The soil was deposited over the centuries by the regular flooding of the Tigris and Euphrates rivers in the river valley known as Mesopotamia, roughly equivalent to present-day Iraq. The soil fertility resulted in an abundance of food and drew migrants from neighboring areas. Attempts to protect the marsh from flooding required significant social organization and led to the building of the earliest communities.

EXTENDED CONTENT

SOCIAL STUDIES – WORLD HISTORY
Standard: Understands the major characteristics of civilization and the development of civilizations in Mesopotamia, Egypt, and the Indus Valley
Benchmark: Understands environmental and cultural factors that shaped the development of Mesopotamia, Egypt and the Indus Valley (e.g., development of religious and ethical belief systems and how they legitimized political and social order; demands of the natural environment; how written records such as the Epic of Gilgamesh reflected and shaped the political, religious, and cultural life of Mesopotamia)

SOCIAL STUDIES – GEOGRAPHY
Standard: Understands how geography is used to interpret the past
Benchmark: Knows significant physical features that have influenced historical events (e.g., mountain passes that have affected military campaigns such as the Khyber Pass, Burma Pass, or Brenner Pass; major water crossings that have affected U.S. history such as the Tacoma Strait in Washington or the Delaware River near Trenton, New Jersey; major water gaps, springs, and other hydrologic features that have affected settlement in the U.S. such as the Cumberland Gap, the Ogallala Aquifer, or the artesian wells of the Great Plains)

ESSENTIAL CONTENT

SCIENCE
Standard: Understands Earth's composition and structure
Benchmark: Knows components of soil and other factors that influence soil texture, fertility, and resistance to erosion (e.g., plant roots and debris, bacteria, fungi, worms, rodents)

CONNECTING IDEA: THE DUST BOWL

The Dust Bowl of the 1930s occurred as the result of years of drought and poor agricultural practices, both of which left the soils dry, infertile, and prone to erosion. The economic impact of the Dust Bowl was enormous, and served to prolong the Great Depression.

EXTENDED CONTENT

SOCIAL STUDIES – U.S. HISTORY
Standard: Understands the causes of the Great Depression and how it affected American society
Benchmark: Understands the environmental and social impact of the Great Depression (e.g., the effects of the Great Depression and Dust Bowl on American farm owners, tenants, and sharecroppers; the effects of the depression on diverse groups and on local communities)

SOCIAL STUDIES – GEOGRAPHY
Standard: Understands how geography is used to interpret the past
Benchmark: Knows significant physical features that have influenced historical events (e.g., mountain passes that have affected military campaigns such as the Khyber Pass, Burma Pass, or Brenner Pass; major water crossings that have affected U.S. history such as the Tacoma Strait in Washington or the Delaware River near Trenton, New Jersey; major water gaps, springs, and other hydrologic features that have affected settlement in the U.S. such as the Cumberland Gap, the Ogallala Aquifer, or the artesian wells of the Great Plains)

ESSENTIAL CONTENT

SCIENCE

Standard: Understands the composition and structure of the universe and the Earth's place in it

Benchmark: Knows how the regular and predictable motions of the Earth and Moon explain phenomena on Earth (e.g., the day, the year, phases of the Moon, eclipses, tides, shadows)

CONNECTING IDEA: CALENDARS/TIME-KEEPING METHODS

Once humans recognized that the motions of the sun, earth, and moon were regular and predictable, they understood that they could use this fact to mark off larger segments of time. For thousands of years, different approaches using astronomy have been used to keep track of time.

EXTENDED CONTENT

SOCIAL STUDIES – HISTORICAL UNDERSTANDING

Standard: Understands and knows how to analyze chronological relationships and patterns

Benchmark: (High School): Understands alternative systems of recording time (e.g., Egyptian, Indian, Mayan, Muslim, Jewish), astronomical systems on which they are based (e.g., solar, lunar, semilunar), their fixed points for measuring time, and their strengths and weaknesses

ESSENTIAL CONTENT

SCIENCE
Standard: Understands the composition and structure of the universe and the Earth's place in it
Benchmark: Knows how the regular and predictable motions of the Earth and Moon explain phenomena on Earth (e.g., the day, the year, phases of the Moon, eclipses, tides, shadows)

CONNECTING IDEA: ASTRONOMICAL DISCOVERIES

The fact that the Earth rotates on its axis was not determined until c. 500 CE, during what is sometimes called India's golden age, the Gupta period. It was during this time that the astronomer Aryabhata was the first to determine the cause of eclipses of the sun and moon and the first to determine that planets and the moon shine by reflected light.

EXTENDED CONTENT

SOCIAL STUDIES – WORLD HISTORY
Standard: Understands the Imperial crises and their aftermath in various regions from 300 to 700 CE
Benchmark: Understands major achievements in technology, astronomy, and medicine in the Gupta period

ESSENTIAL CONTENT

SCIENCE

Standard: Understands the composition and structure of the universe and the Earth's place in it

Benchmark: Knows characteristics and movement patterns of the nine planets in our Solar System (e.g., planets differ in size, composition, and surface features; planets move around the Sun in elliptical orbits; some planets have moons, rings of particles, and other satellites orbiting them)

CONNECTING IDEA: COPERNICAN THEORY

The idea that the Earth and other planets revolved around the sun (rather than the sun revolving around Earth) sparked the beginning of the Scientific Revolution. This controversial idea was slow to take hold, and even up until the time of his death, Copernicus's theory of a heliocentric universe was not commonly accepted.

EXTENDED CONTENT

SOCIAL STUDIES – WORLD HISTORY

Standard: Understands how European society experienced political, economic, and cultural transformations in an age of global intercommunication between 1450 and 1750

Benchmark: Understands the significance of the Scientific Revolution and the Age of Enlightenment (e.g., the impact of astronomical discoveries from Copernicus to Newton; principal ideas of the Enlightenment, from rationalism to theories of education; the word "revolution" and what is meant by the term "Scientific Revolution"; the lives and achievements of significant figures of the Scientific Revolution; how Diderot's encyclopedia contributed to the Age of Enlightenment)

ESSENTIAL CONTENT

SCIENCE
Standard: Understands the principles of heredity and related concepts
Benchmark: Knows that hereditary information is contained in genes (located in the chromosomes of each cell), each of which carries a single unit of information; an inherited trait of an individual can be determined by either one or many genes, and a single gene can influence more than one trait

CONNECTING IDEA: DOMESTICATION OF PLANTS AND ANIMALS
Although we may think of genetic engineering as a modern-day technique, in actuality, selective breeding has been around for thousands of years. The domestication of dogs is an early example of this. Humans would have selected those dogs that responded positively to human behavior.

EXTENDED CONTENT

SOCIAL STUDIES – WORLD HISTORY
Standard: Understands the processes that contributed to the emergence of agricultural societies around the world
Benchmark: Understands how agricultural communities maintained their produce and livestock (e.g., methods used by scholars to reconstruct the early history of domestication and agricultural settlement, how and why human groups domesticated wild grains and animals after the last Ice Age, the importance of controlling food supplies and storing them in the "Neolithic revolution")

ESSENTIAL CONTENT

SCIENCE
Standard: Understands the structure and function of cells and organisms
Benchmark: Knows that disease in organisms can be caused by intrinsic failures of the system or infection by other organisms

CONNECTING IDEA: IMPACT OF DISEASE

Disease has always been a part of human history. At many points in human history it has had a sudden and significant impact on societies. The black plague devastated Europe in the medieval period, killing more than 25 million people. The plague was caused by a bacterium that scientists have recently learned was carried by fleas.

EXTENDED CONTENT

SOCIAL STUDIES – WORLD HISTORY
Standard: Understands patterns of crisis and recovery in Afro-Eurasia between 1300 and 1450
Benchmark: Understands the origins and impact of the plague (e.g., how the plague started and spread across Eurasia and North Africa; the impact of the plague on daily life in urban Southwest Asia and Europe; how Christian and Muslim communities responded to the plague, and how the plague changed the lives of survivors)

Standard: Understands how the transoceanic interlinking of all major regions of the world between 1450 and 1600 led to global transformations
Benchmark: Understands the impact of the exchange of flora, fauna, and pathogens on the Americas and the global population (e.g., the spread of disease throughout the world, and how new disease microorganisms in the Americas devastated indigenous populations; population decline in parts of the Americas within the context of global population trends and growth in Europe and East Asia in the 16th and 17th centuries, origins and routes of flora and fauna exchanged across the globe)

ESSENTIAL CONTENT

SCIENCE

Standard: Understands biological evolution and the diversity of life

Benchmark: Knows evidence that supports the idea that there is unity among organisms despite the fact that some species look very different (e.g., similarity of internal structures in different organisms, similarity of chemical processes in different organisms, evidence of common ancestry)

CONNECTING IDEA: HUMAN EVOLUTION

Scientific evidence, both anatomical and genetic, indicates that modern man and apes are closely related and share a common ancestry.

EXTENDED CONTENT

SOCIAL STUDIES – WORLD HISTORY

Standard: Understands the biological and cultural processes that shaped the earliest human communities

Benchmark: Understands scientific evidence regarding early hominid evolution in Africa (e.g., daily life of individuals and communities in early hunter-gatherer populations; major anthropological discoveries, their locations, and their discoverers)

ESSENTIAL CONTENT

SCIENCE
Standard: Understands the structure and properties of matter
Benchmark: Knows that oxidation involves the combining of oxygen with another substance (e.g., burning, rusting)

CONNECTING IDEA: WORKING WITH METALS

Civilizations are often identified by the technology they used. Ancient people entered the Copper Age once they discovered that when this mineral was heated it could be formed into metal ornaments and tools. During the process of oxidation it became softer, or more malleable. Later, they discovered that smelting tin with the copper produced a much stronger metal, one that could be used for tools and weapons; this advance, the Age of Bronze, was named after the alloy they created.

EXTENDED CONTENT

SOCIAL STUDIES – WORLD HISTORY
Standard: Understands major trends in Eurasia and Africa from 4000 to 1000 BCE
Benchmark: Knows the fundamental inventions, discoveries, techniques, and institutions that appeared from 4000 to 1000 BCE, and understands the significance of bronze technology for economic, cultural, and political life

ESSENTIAL CONTENT

SCIENCE

Standard: Understands the structure and properties of matter

Benchmark: Knows that states of matter depend on molecular arrangement and motion (e.g., molecules in solids are packed tightly together and their movement is restricted to vibrations; molecules in liquids are loosely packed and move easily past each other; molecules in gases are quite far apart and move about freely)

CONNECTING IDEA: ENERGY IN SOCIETY

When water is heated to the boiling point, the steam that results has molecules that contain lots of energy as they move around quickly. This energy can be used to run a steam engine that performs work. The invention of the steam engine had a significant impact on transportation.

EXTENDED CONTENT

SOCIAL STUDIES – UNITED STATES HISTORY

Standard: Understands how the industrial revolution, increasing immigration, the rapid expansion of slavery, and the westward movement changed American lives and led to regional tensions

Benchmark: Understands the major technological developments that influenced land and water transportation, the economy, international markets, and the environment between 1801 and 1860 (e.g., the importance of the spinning jenny, steam locomotive, and telegraph; the development of the canal system after 1825 and railroad system after 1860)

ESSENTIAL CONTENT

SCIENCE
Standard: Understands forces and motion
Benchmark: Understands general concepts related to gravitational force (e.g., every object exerts gravitational force on every other object; this force depends on the mass of the objects and their distance from one another; gravitational force is hard to detect unless at least one of the objects, such as the Earth, has a lot of mass)

CONNECTING IDEA: USING GRAVITY

The enormous energy required to move ships across the Panama Canal from the Atlantic to the Pacific comes from gravity. Building the canal was a significant engineering achievement that dramatically improved trade and transport between the eastern and western hemispheres. The canal slopes from a high central lake, which is continuously fed by the Chagres River, to either ocean. Each slope is made up of a series of locks that descend step-wise to the sea from the lake. Water from the lake fills each lock to raise a ship one lock at a time to the high mid-point of the canal. Once a ship is across the central lake, it can descend again to the other ocean through a descending series of locks. As it enters each lock, the water is released, lowering the ship to the next lock, until it is once again at sea level.

EXTENDED CONTENT

SOCIAL STUDIES – UNITED STATES HISTORY
Standard: Understands the changing role of the United States in world affairs through World War I
Benchmark: Understands various U.S. foreign policies in the early part of the 20th century (e.g., the Open Door policy; places the U.S. claimed, occupied, or protected in the Caribbean after the Spanish-American War; the importance of the Panama Canal)

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