Grade 7 Standards and Learning Activities

SCIENTIFIC THINKING AND INQUIRY

7.1. Broad Concept: Scientific progress is made by asking relevant questions and conducting careful investigations. As a basis for understanding this concept, and to address the content in this grade, students should develop their own questions and perform investigations.

Students:

1. Explain that when similar investigations give different results, further studies may help to show whether the differences are significant.
2. Explain why it is important in science to keep honest, clear, and accurate records.
3. Explain why research involving human subjects requires that potential subjects be fully informed about the risks and benefits associated with the research and that they have the right to refuse to participate.
4. Recognize testable hypotheses in investigations that pertain to the content under study, and write instructions that others can follow in carrying out the investigation.
5. Communicate the steps and results from an investigation in written reports and verbal presentations.
6. Incorporate circle charts, bar and line graphs, diagrams, scatter plots, and symbols into writing, such as lab or research reports, to serve as visual displays of evidence for claims and/or conclusions.
7. Recognize whether evidence is consistent with a proposed explanation. Know that different explanations can be given for the same evidence, and that partial evidence may be exploited for reasons other than truth seeking.
8. Question claims based on vague attributes or on authority, such as "leading doctors say," or based on statements made by celebrities or others outside the area of their particular expertise.

Examples

Students investigate recent lawsuits against pharmaceutical companies regarding misleading research data. They write essays on what constitutes honesty and integrity, and the potential impacts of not telling the truth (7.1.2).

Students examine the issue of animal testing, such as the report on animal testing given by the National Academies (fermat.nap.edu/catalog/10733.html). After investigating, they set their own rules for the more difficult procedure of asking humans to become test subjects (7.1.3).

Students hypothesize and then investigate the ways in which CO_2 concentration affects plant growth or the affect of UV light on the behavior of mealworms (information available at www.sciserv.org/isef) (7.1.4).

Students research recent HIV/AIDS data for trends, broken down into categories by race, year, or geographical areas. They discuss the effect that information has on their perceptions of AIDS (information available at www.cdc.gov/hiv/) (7.1.6).

Students critique a newspaper article that reports that certain childhood eating habits cause adult diseases for proper use of evidence (7.1.7).

Students examine current diet ads promoting new weight-loss methods. They examine evidence about variations in diet for different body types. They evaluate the claims for weight loss, based on their investigation (7.1.8).

SCIENCE AND TECHNOLOGY

7.2. Broad Concept: Although each of the human enterprises of science and technology has a character and history of its own, each is dependent on and reinforces the other. As a basis for understanding this concept,

Students:

1. Explain types of technology that are developed and in use, such as in agriculture, manufacturing, sanitation, medicine, warfare, transportation, information processing, and communication.

2. Know how technologies having to do with food production, sanitation, and disease prevention have dramatically changed how people live and work, and have resulted in changes in factors that affect the growth of human population.

Examples

Students discuss how engineers design things by using their knowledge of the way that animals move, such as how birds and wings influence airplane design (information available at animal.discovery.com/convergence/spyonthewild/birdtech/birdtech.html) (7.2.1).

Students explore the current technology being used to monitor, contain, and prevent the spread of the bird flu as a global pandemic (7.2.2).

BIOLOGICAL CLASSIFICATION

7.3. Broad Concept: Similarities are used to classify organisms because they may be used to infer the degree of relatedness among organisms. As a basis for understanding this concept,

Students:

1. Recognize and describe that a key distinction among organisms is between autotrophs, such as green plants (which use energy from sunlight to make their own food), and heterotrophs, such as animals and fungi (which consume other organisms as food and harvest energy from them).

2. Recognize and describe that biological classifications are based on how organisms are related: Organisms are classified into a hierarchy of groups and subgroups, with species as the most fundamental unit.

3. Recognize and describe the definition of a species as a group or population of organisms closely resembling one another that can mate and breed to produce fertile offspring.

4. Describe how similarities among organisms are found in external and internal anatomical features, including specific characteristics at the cellular level, such as the number of chromosomes.

Examples

Students research a zoo Web site, choose animals they like, and using their full scientific classification names, show relationships between those animals (7.3.2).

Students create an operational definition of "species," and then they research the status of the mule, which is a result of a cross between species horse and species donkey (7.3.3).

Students examine the diagrams of "arm" bones of a human, bat, whale, horse, and frog, and note where length and/or diameter have changed based on the function of the appendage by the organism and where bones have fused to assist in function (information available at www.cet.edu/ete/modules/msese/earthsysflr/adapt.html) (7.3.4).

CELL BIOLOGY

7.4. Broad Concept: All living things are composed of cells, from just one to many quadrillions, whose details usually are visible only through a microscope. As a basis for understanding this concept,

Students:

1. Investigate and explain that all living things are composed of one or more cells, that cells are organisms' basic units of structure and function, and that cells come only from existing cells (Theodor Schwann's and Matthias Schleiden's cell theory).
2. Describe that the way in which cells function is similar in all living organisms.
3. Explain that in those cells that contain a nucleus (*eukaryotic* plant and animal cells), the nucleus is the main repository for genetic information.
4. Identify cells such as bacteria and blue-green algae as *prokaryotes*. Explain that *prokaryotic* cells differ from *eukaryotic* cells most prominently in that they don't have a membrane-bound nucleus. Know their genetic information is in a threadlike mass, often a very long loop of DNA.
5. Know intracellular bodies with specific functions are called *organelles.* Describe the important organelles among them, such as mitochondria, which liberate energy for the work that cells do, and chloroplasts, which capture sunlight energy for photosynthesis.
6. Describe that plant cells have chloroplasts and a cellulose cell wall and that animal cells do not.
7. Observe and explain that about two-thirds of the mass of a typical cell is accounted for by water and that water gives cells many of their properties.
8. Describe how the most basic chemical functions of organisms, such as extracting energy from food and getting rid of wastes, are started or carried out completely within the cell.
9. Explain how cells in multicellular organisms continually divide to make more cells for growth and repair, and how various organs and tissues function to serve the needs of cells for food, air, and waste removal.
10. Recognize that many organisms are single-celled (e.g., bacteria, yeasts), and explain how this one cell must carry out all of the basic functions of life.
11. Construct a chart and describe that multicellular organisms are organized hierarchically from cells to tissues to organs to organ systems to organisms.

Examples

Students note the basic cell processes in which air breaks down food (interactive cell explorer site is available at www.exploratorium.edu/traits/stuff.html#) (7.4.2).

Students build and observe model ecosystems with freshwater plants and snails to demonstrate the relationship between photosynthesis and cellular respiration. Students make and record observations when they place the model ecosystem in the sunlight (7.4.5).

Students observe plant and animal cells using a microscope. Students sketch and label the structures observed and compare and contrast the two types of cells (7.4.6).

Students list the effects of a common microbial disease, such as strep throat or malaria, to the host human, and they describe what the microbes are doing to survive (7.4.8).

CELL BIOLOGY (CONTINUED)	
	Students chart the cells that would come into contact with a candy bar from the time it is eaten to the time it is completely expended. They discuss issues of homeostasis, cell reproduction, and communication (7.4.9). *Students observe yeast carrying out life functions, such as respiration and reproduction (7.4.10).*

GENETICS

7.5. Broad Concept: Every organism requires information in the form of a set of instructions that specifies its traits. Those traits may be modified by environmental influences. As a basis for understanding this concept,

Students:

1. Describe that heredity is the passage of information for developing and maintaining the organism's body from one generation to another, and that genes are the basic units of heredity; genes are made of DNA, consisting of very long molecules located in the chromosomes of each cell.
2. Explain how, in asexual reproduction, offspring are an almost identical copy of the mother cell.
3. Explain how, in sexual reproduction, a single reproductive cell from a female (female gamete, egg, or ovum) merges with a specialized cell from a male (male gamete or spermatozoon) to make a fertilized egg (zygote). This carries genetic information from both parental gametes and multiplies to form the complete organism.
4. Recognize and describe that new varieties of cultivated plants, such as corn and apples, and domestic animals, such as dogs and horses, have resulted from selective breeding, over multiple generations, for particular traits.
5. Explain how the use of genetic-engineering techniques can speed the process of creating new varieties and introduce characteristics not easily available by selective breeding, and can make possible more precise modifications involving the manipulation of just one or a few genes.

Examples	
	Students observe the process of cell division to show how DNA is copied and split between two new cells (information available at www.exploratorium.edu/traits/cell_explorer.html) (7.5.2). *Students research different canine breeds and the traits selected that make them unique (7.5.4).* *Students research superbugs that are resistant to antibiotics (7.5.5).*

BIOLOGICAL EVOLUTION

7.6. Broad Concept: Biological evolution accounts for the diversity of species developed through gradual processes over many generations. As a basis for understanding this concept,

Students:

1. Describe that biological variation (phenotype variation) is the raw material on which natural selection operates.
2. Explain how Darwin's research and that of his followers supported a concept of differential survival in terms of fitness (i.e., given the potential exponential increase of offspring and the only linear potential increase of resources, favorable variations that aid individual organisms in their survival in a given environment will confer on those organisms a greater reproductive success for that variety).
3. Describe how biological evolution results primarily from the action of natural selection on the available variation in a population of organisms.
4. Explain how independent lines of evidence drawn from geology, fossils, comparative anatomy, and molecular biology provide the firm basis of evolutionary theory.
5. Using specific examples, explain that extinction of a species is a result of mismatch of adaptation and the environment.

Examples

Students research the similarities in gene samples between different organisms (e.g., human to chimp — 99 percent, and mouse to human — 60 percent to 70 percent) (7.6.1).

Students use marine animals in the Great Barrier Reef as examples of competition and cooperation for survival (7.6.2).

Students discuss the turtles, finches, and lizards unique to each of the Galapagos Islands and relate these phenomena to Darwin's natural selection (7.6.3).

Students graph the number of species that have become extinct in the last 50 years.

Students relate the information in their graph to the environmental changes in the ecosystem (7.6.5).

THE HUMAN BODY

7.7. Broad Concept: Human beings have body systems for obtaining and providing energy, defense, reproduction, and the coordination of body functions. As a basis for understanding this concept,

Students:

1. Describe the specific functions and roles of each major human body system, including the digestive, respiratory, excretory, reproductive, circulatory, nervous, endocrine, musculoskeletal, and immune systems.
2. Explain that human beings have many similarities and differences, and the similarities make it possible for human beings to donate blood and organs to one another.
3. Explain how the amount of food energy (usually measured in calories) that a person requires varies with body weight, age, sex, activity level, and metabolic rate.

THE HUMAN BODY (CONTINUED)	
4. Research and explain that regular exercise is important to maintain a healthy heart/lung (cardiovascular) system, good muscle tone, and strong bone structure.	
5. Identify specific examples of how viruses, bacteria, fungi, and more complex parasites may infect the human body and interfere with normal body functions.	
6. Explain how white blood cells engulf invaders or produce antibodies that attack invaders or mark the invaders for killing by other white blood cells. Know that these white cells are part of a larger system that produces "immunity" or the capacity to resist disease due to pathogens.	
7. Know that antibodies produced in response to an invader can remain for long periods in the system and can fight off subsequent invaders of the same kind.	
8. Recognize that the environment may contain dangerous levels of substances that are harmful to human beings. Therefore, the good health of individuals requires monitoring the soil, air, and water, as well as taking steps to keep them safe.	
9. Research and explain the contributions of key scientists that have studied infection by disease organisms (germs), including Anton van Leeuwenhoek, Louis Pasteur, Joseph Lister, Robert Koch, Dimitri Iwanowski, and Alexander Fleming.	
10. Explain how fundamental changes in health practices have resulted from the establishment of the germ theory of disease.	
Examples	*Students create a game and directions for other students to role-play the functions of the major body systems (helpful animations are at science.howstuffworks.com) (7.7.1).* *Students calculate their total and average daily caloric intake and energy use to determine their net calorie gain or loss. They relate this to gaining or losing weight over time (7.7.3).* *Students measure and record their resting heart rates, and then complete simple activities (e.g., jogging in place, walking up/down stairs). They measure and record their active heart rates. Students follow up by maintaining an exercise diary/journal and relating their activity levels to heart health in the future (7.7.4).* *Students hypothesize why outbreaks of colds and flu tend to peak in the winter and discuss ways to prevent the spread of illness (7.7.5).* *Students investigate the structure and spread of microbes through a simulated cholera outbreak (simulation available at medmyst.rice.edu/html/mission2.html) (7.7.5 and 7.7.6).* *Students monitor, chart, and graph local air quality for seven days. They report on particulate and gas pollution, and the health effects, hazards, and alerts (information available at www.mwcog.org/environment/air/forecast) (7.7.8).* *Students make pamphlets outlining personal hygiene practices that inhibit the spread of germs and compare them to medical practices from the past (7.7.10).*

ECOLOGY

7.8. Broad Concept: Organisms in ecosystems exchange energy and nutrients among themselves and with the physical environment. As a basis for understanding this concept,

Students:

1. Recognize that in all environments, such as freshwater, marine, forest, desert, grassland, mountain, farms, cities, and others, organisms with similar needs and living strategies compete with one another for resources, including food, space, water, air, and shelter.
2. Describe how two types of organisms may interact in a competitive or cooperative relationship, such as producer/consumer, predator/prey, parasite/hosts, or as symbionts.
3. Illustrate and explain how plants use the energy from light to make simple sugars, and more complex molecules, from carbon dioxide and water through a process called *photosynthesis.* Understand how this produces food that can be used immediately or stored for later use.
4. Create a food web to explain how energy and matter are transferred between producers, primary consumers, and secondary consumers.
5. Describe how organisms that eat plants break down the plant structures to produce the materials and energy that they need to survive, and in turn, other organisms consume them.
6. Explain how dead plants and animals, broken down by other living organisms (especially microorganisms and fungi), contribute to the cycling of matter through the system as a whole.
7. Describe how, as any population of organisms grows, it is held in check by one or more environmental constraints (e.g., depletion of food or nesting sites, increased numbers of predators or parasites).
8. Explain why in urban environments a species (mostly human beings) settles in dense concentrations.
9. Describe that all organisms, including the human species, are part of and depend on two main interconnected global food webs: the ocean food web and the land food web.
10. Recognize that entire species may prosper in spite of the poor survivability or bad fortune of individuals.

Examples

Students play "Oh, Deer!" (Project Wild) in which students take roles as deer, space, shelter, food, and water. Conditions are altered to affect deer population size, for example, if one item is removed (information available at teachers.net/gazette/MAY02/stanimirovic2.html) (7.8.1).

Students create a series of "want" ads — promoting cooperative relationships of symbionts (lichens: algae and fungi); predator/prey (Venus's-flytrap and insect); parasite/host (heartworm/dog); producer/consumer (plankton/baleen whales) (7.8.2).

Students examine the variety of relationships in the Great Barrier Reef. They explain what would happen if one of the groups was altered by some environmental condition (7.8.2).

Students bury a dead animal or plant in a specific location outside. They exhume the object for study on a periodic basis (7.8.5 and 7.8.6).

Students establish a compost bin. They analyze the decay of the contents and the gradual appearance of various organisms over time (7.8.6).

ECOLOGY (CONTINUED)	
	Students play "The Fox and the Rabbit" (Project Wild). Students assume roles of deer, shelter, water, food, space, and foxes through different rounds/seasons where there is a drought (water players removed), productive spring, harsh winter, etc. (7.8.7).
	Holding yarn and index cards with the names of marine organisms printed on them, students weave an intricate marine food/energy web, connecting producers to consumers (7.8.9).
	Students identify a pest in the immediate environment and use an understanding of food webs to propose and test a way to eliminate the pest without introducing environmental poisons (7.8.9).