The Department's Educational Philosophy

We believe that students should be exposed to the process of scientific inquiry so they can acquire and interpret scientific knowledge and begin to realize the wider applicability of scientific problem-solving methods. By exposing them to a variety of scientific disciplines, they become aware of the many possible directions in which this inquiry may lead.

Guiding Principles

- Inductive and deductive problem-solving skills are central to science education.
- Students must be able to collect and analyze data and formulate hypotheses.
- Students should be able to use or design a strategy for testing scientific concepts.
- A comprehensive science program will emphasize the delicate checks and balances in man's abiotic and biotic environments.
- Science is integrally related to mathematics.
- An effective science program builds students' ability to communicate accurately and precisely.
- An effective science program stresses both cooperative and independent learning.

GENERAL SCIENCE: GRADE 8

Course Frequency: Full-year course, five times per week
Credits Offered: None
Prerequisites: None

Background to the Curriculum

The curriculum is designed to teach science by thinking, sharing, and writing about what students do and discover. It is activity and inquiry based. The programs have many activities designed to challenge students' thinking skills while introducing them to realistic methods of science. It is supplemented by the following texts: SciencePlus (Level Blue) and Holt Science and Technology – Forces, Motion and Energy.

The program emphasizes concept and skill development. The seventh-grade program has a language emphasis, while the eighth-grade focus is on process.

The curriculum meets most of the science strands of the current Massachusetts Science and Technology Frameworks.

Unit 1 – Life Processes

Core Topics/Questions/Concepts/Skills

- How do living things eat and use energy?
- Why is water important to living things?
- What role does osmosis play in living things?
- How is the environment affected by plants and animals?

Unit-End Learning Objectives

Students will study and explore some of the processes of living things on a cellular level. The process of photosynthesis, water movement, diffusion, osmosis, and transpiration are investigated by a close examination of the external and internal structures of the leaf. The process of respiration and the release of stored energy is then related to digestion, circulation and excretion. Students are asked to consider the balance of carbon dioxide and oxygen as it relates to the balance of nature, specifically global warming. Upon completion of this unit, students should be able to do the following.

1] Explain how all food comes from plants.
2] Describe the process of photosynthesis.

3] Identify the external structures of the leaf, including blade, petiole, and vein.
4] Describe the structure and function of the following internal structures of the leaf: cuticle, epidermis, mesophyll, vacuoles, guard cells, stoma.
5] Diagram the internal structure of a leaf.
6] Explain the role of chlorophyll in photosynthesis.
7] Identify at least three properties of water.
8] Demonstrate the process of transpiration.
9] Explain how water is transported from the roots of a plant to the leaves by the processes of osmosis, capillary action, adhesion and cohesion.
10] Demonstrate the process of osmosis by using a semipermeable membrane.
11] Explain the role of digestion in the process of respiration.
12] Diagram the interdependence of plants, animals and the atmosphere.
13] Identify at least two consequences of increased carbon dioxide in the atmosphere.
14] Recognize that all organisms are composed of cells and that many organisms are single celled.
15] Compare and contrast plant and animal cells, including major structures.
16] Recognize that within cells many of the basic functions of organisms are carried out.

Unit 2 – Particles

Core Topics/Questions/Concepts/Skills

- How are observations and inferences used to create scientific models?
- What evidence is there that matter is made of particles?
- How has atomic theory changed over time?
- What is the kinetic molecular theory of matter?

Unit-End Learning Objectives

Students examine the particle model of matter. The concept of size as it relates to the structure of matter is explored, and the use of models to study objects that cannot be seen is introduced. Students examine how observations and inferences relate to each other and how they are different. Upon completion of this unit, students should be able to do the following.

1] Observe that the sizes of objects can be compared using an exponential scale.
2] Explain how exponential form is used to express very large and very small numbers.
3] Explain that observations are information obtained by the use of the senses.
4] Explain that inferences are supported by circumstantial evidence.
5] Examine models as representations of events or objects in the real world that can be used to test hypotheses.
6] Examine the evidence for the particle model of matter.
7] Develop a model to explain observations of dissolving and the pouring and mixing of substances.
8] Explain that all matter is composed of atoms.
9] Recognize that there are a finite number of naturally-occurring elements.
10] Demonstrate that all atoms of the same element have the same properties.
11] Explain that atoms combine to form molecules.
12] Identify compounds as consisting of different kinds of atoms.
13] Demonstrate that the molecules of different substances have different sizes.
14] Determine that atoms and molecules are extremely small.
15] Examine how some materials allow certain substances to pass through while blocking others.
16] Explain that the particles of matter are in constant motion.
17] Demonstrate that gas particles are farther apart than are the particles of liquids and solids.
18] Explain that heating a substance causes the particles of the substance to move faster and farther apart.
19] Demonstrate that cooling matter causes the particles of matter to slow down and move closer together.
20] Explain that air expands when heated.
21] Recognize that not all substances expand and contract at the same rate.
22] Explain that the temperature remains constant at a substance's melting or freezing point until all the material has either melted or frozen.
23] Define endothermic and exothermic changes.
24] Demonstrate that a change of state requires substances to absorb or release heat energy.
25] Construct wet-bulb thermometers to study the process of evaporative cooling.
26] Demonstrate that different materials with the same volume may have different masses.
27] Explain that the mass of a given volume of a substance is an identifiable property of that substance.
28] Investigate Dalton's theory of matter, which states that all matter is made up of atoms.
29] Discuss Thomson's refinement of the atomic theory, which states that the atom contains both a positive and negative charge.
30] Identify the parts of the atom.
31] Discuss Rutherford's discovery of a positively charged nucleus.
32] Discuss Bohr's planetary model of the atom.
33] Discuss the relative sizes of protons, neutrons, and electrons.

34] Describe the four states of matter.
35] Explain and give examples of how mass is conserved in a closed system.
36] Differentiate between physical and chemical changes.

Unit 3/4 – Forces, Motion, Work & Energy

Core Topics/Questions/Concepts/Skills

- How can you recognize a force?
- How do mass and weight differ?
- How do distance and time reflect speed?

Unit-End Learning Objectives

The concepts of force and motion are developed in ways that allow students to draw from personal experiences, observations, and previous knowledge. They also learn about the scientific concepts of *force*, *motion*, *energy*, *work* and *power* that underlie the operation of machines. They learn about different kinds of *energy* and also study efficiency, energy transformation, mechanical advantage and simple machines, such as levers, pulleys and inclined planes. In classroom explorations, students in the classroom have the chance to develop problem-solving skills by designing and building machines and by performing calculations. Upon the completion of this unit, students should be able to do the following.

1] Identify forces as pushes or pulls exerted by one object (the agent) upon another object (the receiver).
2] Infer what the effect of a force will be on the receiver, such as changing its shape, motion, direction and/or speed.
3] Recognize different types of forces, including buoyant, magnetic, electrical, gravitational, elastic and frictional.
4] Recognize the difference between contact and non-contact forces.
5] Understand that every object in the universe exerts an attractive (gravitational) force on every other object.
6] Recognize that the size of the gravitational force depends upon the masses of the objects and the distance between them.
7] Recognize that elastic materials (examples: rubber bands, springs) stretch uniformly when masses are added to them.
8] Identify that the unit of force, the newton (N), is approximately the weight of 100g on the Earth's surface.
9] Recognize that the size of a force can be estimated and measured using a force meter.
10] Understand that mass is the quantity of matter in an object, is constant for an object taken anywhere in the universe, is measured on an equal arm balance or pan balance, and is measured in grams (g) and kilograms (kg).

11] Understand that weight is a measure of the gravitational force exerted by the Earth on an object, varies as the object moves away from the Earth's surface, is measured on a spring scale, and is measured in newtons (N).
12] Identify factors that influence the magnitude of frictional forces (types of surfaces, mass, rolling/starting/sliding motions).
13] Recognize that lifting an object (no friction) requires more force than any dragging/pushing motion.
14] Understand that friction results from the interlocking of opposing surfaces as they move past one another; understand how to reduce friction (lubrication or separation of opposing surfaces with round objects).
15] Recognize that friction opposes motion, produces heat, and causes surfaces to wear away.
16] Identify situations where friction is an asset or a liability.
17] Understand that the inertia of an object is its tendency to remain at rest when already at rest and to remain in motion, in the same direction and at the same speed, when already in motion unless acted on by an unbalanced (outside) force.
18] Recognize that the amount of inertia that an object has depends on its mass.
19] Recognize that both action and reaction forces can produce or affect the motion of the objects upon which the forces are applied.
20] Recognize that the action force of one object upon another is equaled by a reaction force in the opposite direction.
21] Understand that motion is the change of an object when compared with a reference point.
22] Understand that speed is the rate at which an object moves, as measured by the distance it covers in a unit of time.
23] Understand that acceleration is a change in the speed and/or direction of motion.
24] Recognize that the momentum of an object is a result of mass x velocity.
25] Recognize how the motion of an object may be represented on a graph.
26] Identify the four forces that act on an object in flight (lift, thrust, gravity, and drag).
27] Show that arrows represent the direction and magnitude of forces.
28] Define *work* in a scientific sense – that it is done only when a *force* moves an object.
29] Perform a calculation of *work* using the formula: Work = Force x Distance.
30] Describe how *energy* is transferred from one object to another when *work* is done.
31] Recognize that, when *potential energy* is released, it is converted into *kinetic energy*.
32] Explain that an object in motion possesses *kinetic energy*.
33] Describe that *work* may result in changing potential energy to kinetic energy.
34] Understand that there are many different forms of *energy* and that one form of *energy* may change into or produce another form.
35] Recognize that many types of devices act as *energy* converters.
36] Understand that *energy* can be transferred and transformed but the total amount of *energy* remains the same.

Unit 8 – Continuity of Life

Core Topics/Questions/Concepts/Skills

- What are four activities that all living things share?
- How are traits inherited in sexual and asexual reproduction?
- What are the parts of the (plant/animal) cell, and what are their functions?
- How are cells organized as organisms evolve from simple creatures to complex organisms?

Unit-End Learning Objectives

Students are introduced to genetics – the study of how characteristics are passed from one generation to the next. Topics include: inherited characteristics of living things; the experimental evidence of how life comes only from pre-existing life; the observation of living cells and learning about cell division through mitosis; learning about Mendelian genetics and how many inherited traits appear in predictable patterns in the offspring of a genetic cross; examination of the structure and function of DNA and identifying its relationship to chromosomes and genes; the investigation of the importance of the environment to the development of living things and discussion of the future of genetic research. On completion of this unit, students should be able to do the following.

1] Understand why members of the same family often resemble one another.
2] Explain why people who are not related may share certain physical traits.
3] Understand that all living things demonstrate essential properties of life.
4] Describe how all life comes from pre-existing life.
5] Describe how Francesco Redi performed the crucial controlled experiment that proved life cannot arise from nonliving matter.
6] Recognize that any process in a living cell is controlled by the cell's nucleus.
7] Identify the process by which a cell's nucleus divides to produce two identical nuclei – mitosis.
8] Discuss how reproduction can be either sexual or asexual.
9] Demonstrate how traits are determined by pairs of inherited factors.
10] Diagram the result when hybrids are crossed: a 3-to-1 ratio of dominant to recessive traits appears in the next generation.
11] Explain how offspring inherit one factor for a specific trait from each parent.
12] Describe how heredity and the environment contribute to an organism's development and well-being.
13] Understand that, if something goes wrong with the genetic code, it is likely to result in the abnormal development of an organism.
14] Explain how biologists can manipulate the genetic material of living cells.
15] Infer that advances in the study of genetics may have a profound effect on the future.
16] Recognize that genetic engineering involves ethical questions that society will have to answer.
17] Describe the structure and function of DNA and distinguish among replication, transcription, and translation.

18] Differentiate between dominant, recessive and co-dominant genes.
19] State Mendel's Law of Segregation and independent assortment.
20] Use Punnett squares to determine the genotype and phenotype of mono hybrid crosses.

Assessment

Quizzes, Tests, Projects

Materials and Resources

Text

SciencePlus Technology and Society (Level Blue). Holt, Rinehart and Winston, 2002.

Forces, Motion, and Energy, Holt Science and Technology. Holt, Rinehart and Winston, 2007. (For Physics Unit.)