Standard 7—Interdisciplinary Problem Solving  

Connections

1. The knowledge and skills of mathematics, science, and technology are used together to make informed decisions and solve problems, especially those relating to issues of science/technology/society, consumer decision making, design, and inquiry into phenomena.

Students:

- analyze science/technology/society problems and issues on a community, national, or global scale and plan and carry out a remedial course of action.
- analyze and quantify consumer product data, understand environmental and economic impacts, develop a method for judging the value and efficacy of competing products, and discuss cost/benefit and risk/benefit tradeoffs made in arriving at the optimal choice.
- design solutions to real-world problems on a community, national, or global scale using a technological design process that integrates scientific investigation and rigorous mathematical analysis of the problem and of the solution.
- explain and evaluate phenomena mathematically and scientifically by formulating a testable hypothesis, demonstrating the logical connections between the scientific concepts guiding the hypothesis and the design of an experiment, applying and inquiring into the mathematical ideas relating to investigation of phenomena, and using (and if needed, designing) technological tools and procedures to assist in the investigation and in the communication of results.

This is evident, for example, when students:

▲ analyze the issues related to local energy needs and develop a viable energy generation plan for the community.
▲ choose whether it is better to purchase a conventional or high definition television after analyzing the differences from quantitative and qualitative points of view, considering such particulars as the number of scanning lines, bandwidth requirements and impact on the frequency spectrum, costs, and existence of international standards.
▲ design and produce a prototypical device using an electronic voltage divider that can be used to power a portable cassette tape or CD player in a car by reducing the standard automotive accessory power source of approximately 14.8 volts to a lower voltage.
▲ investigate two similar fossils to determine if they represent a developmental change over time.

Strategies

2. Solving interdisciplinary problems involves a variety of skills and strategies, including effective work habits; gathering and processing information; generating and analyzing ideas; realizing ideas; making connections among the common themes of mathematics, science, and technology; and presenting results.

Students participate in an extended, culminating mathematics, science, and technology project. The project would require students to:

- work effectively
- gather and process information
- generate and analyze ideas
- observe common themes
- realize ideas
- present results

This is evident, for example, when students, addressing the issue of emergency preparedness in an interdisciplinary science/technology/society project:

▲ are given a scenario—survivors from a disaster are stranded on a mountaintop in the high peaks of the Adirondacks—they are challenged to design a portable shelter that could be heated by the body heat of five survivors to a life sustaining temperature, given an outside temperature of 20°F. Since the shelter would be dropped to survivors by an aircraft, it must be capable of withstanding the impact. Students determine the kinds of data to be collected, for example, snowfall during certain months, average wind velocity, R value of insulating materials, etc. To conduct their research, students gather and analyze information from research data bases, national libraries, and electronic communication networks, including the Internet.
▲ design and construct scale models or full-sized shelters based on engineering design criteria including wind load, snow load, and insulating properties of materials. Heat flow calculations are done to determine how body heat could be used to heat the shelter. Students evaluate the trade-offs that they make to arrive at the best solution; for example, in order to keep the temperature at 20 degrees F., the shelter may have to be small, and survivors would be very uncomfortable. Another component of the project is assembly instructions—designed so that speakers of any language could quickly install the structure on site.
▲ prepare a multimedia presentation about their project and present it to the school’s ski club.
Skills and Strategies for Interdisciplinary Problem Solving

Working Effectively: Contributing to the work of a brainstorming group, laboratory partnership, cooperative learning group, or project team; planning procedures; identifying and managing responsibilities of team members; and staying on task, whether working alone or as part of a group.

Gathering and Processing Information: Accessing information from printed media, electronic databases, and community resources and using the information to develop a definition of the problem and to research possible solutions.

Generating and Analyzing Ideas: Developing ideas for proposed solutions, investigating ideas, collecting data, and showing relationships and patterns in the data.

Common Themes: Observing examples of common unifying themes, applying them to the problem, and using them to better understand the dimensions of the problem.

Realizing Ideas: Constructing components or models, arriving at a solution, and evaluating the result.

Presenting Results: Using a variety of media to present the solution and to communicate the results.

Where Does Electricity Come From?

Students will be able to explain how electricity is generated and how the rate at which electricity is generated is related to the appliance being operated.

Interdisciplinary Connections

These activities focus on the ways in which electricity is generated:

- **Technology**: Technology is used not only to generate electricity but also to transmit it to where it is needed. Find out what technologies are important in the transmission of electricity; of particular interest is the importance of electric transformers and electric insulation.
- **Social Studies**: Learn about the early history of the generation of electricity in the United States. In particular, you will want to learn about the role of Thomas Alva Edison, whose Pearl Street Station generated the first commercial electricity, and also about the roles of George Westinghouse and Nikola Tesla.

- **Language Arts**: When electricity was discovered, new words were developed to describe it. Make a list of all the words you can find that were developed specifically to describe electricity, and indicate which were “borrowed” and which were coined at that time.
- **Mathematics**: The electricity generated at power plants today is known as “alternating current,” because it flows alternately in one direction and then in another (or is alternately positive and negative). A graph of alternating current in relation to time is known as a “sine curve.” Find out more about the sine curve and its many other uses in mathematics, science, and technology.
- **Health**: Because life-sustaining equipment in hospitals is so reliant on the generation of electricity, hospitals have their own backup source of electric power to be used in case commercial generation of electricity is interrupted. Inquire about your local hospital’s emergency generating system, including the amount of power it can generate and its duration.
- **Home and Career Skills**: Trace the transmission of power to your household from the power plant that generates it, or from a nearby major transmission substation. (In the event of a power failure, you will know that something went wrong along the line you have traced.)
- **Arts**: The alternating current generated in the United States has a frequency of 60 Hertz (Hz). This means that the direction of the current reverses from positive to negative and back to positive 60 times every second. Find out which aspects of the performing arts are dependent upon this frequency.
- **Foreign Languages and Cultures**: Choose another nation in the world. Find out how the voltage and frequency of alternating current generated in that nation differs from that in the United States.