Invention-Innovation-Inquiry
A National Science Foundation Project

I^3 Unit Summaries and Learning Goals

Innovation: Inches, Feet and Hands

Summary Of Unit

This unit is about innovation, measurement, and anthropometrics, which is the study of the size of human form. Students will be using an engineering design process to design and develop an improved product that is used by the human hand. They will be studying the sizes of the human hand and using these measurements to estimate sizes of various objects. They will also be improving their measurement ability through various activities.

Learning Goals

Students will:

1) Demonstrate an understanding of basic design concepts as they relate to measurement and human form.
2) Explain and demonstrate how an engineering design process can be used to improve technological devices.
3) Describe limitations for a given device or design.
4) Realize that with innovation, technological devices can be improved in many different ways.

Invention: The Invention Crusade

Summary Of Unit

This unit will help students in Grades 5 and 6 to explore the process of developing an idea into an invention. Students are asked to invent and construct a working model or prototype of a gadget that will help a small child to do a household task. The culminating event is a "Kids Better Living Home Show" where the young inventors will explain their ideas behind their gadget and give other elementary students an opportunity to try the new inventions.

Learning Goals

Students will:

1) Explain and demonstrate how ideas can become inventions by using an engineering design process.
2) Recognize that products are invented to meet specific needs and wants.
3) Describe the general characteristics of famous inventors and their inventions.
4) Document their inventive thinking with sketches and notations, in an Inventor's Journal.

Manufacturing: The Fudgeville Crisis

Summary Of Unit

Students will explore and identify how the process and preservation of food has changed over time and will see how raw materials can be processed into fudge. Throughout the unit students will be divided into four different teams and each team will become a different company. Each company will experiment with how material can be formed to keep a desired shape, how food can be packaged to keep it fresh, and the importance of cleanliness in a food production environment. As a culminating activity, each team will mass-produce and package their fudge for a fudge festival.

Learning Goals

Students will:

1) Analyze the causes of change in food quality over time.
2) Design a package that can extend the freshness of a food product.
3) Design a production system for a food product and use it to produce shaped fudge.
4) Recognize the importance of following and maintaining cleanliness when handling food products.

Construction: Buildings and Beams

Summary Of Unit

In this unit students act as structural engineers. The students will design and construct at least two laminated paper beams. They will explore forces that act on structures and discover that the strength of a beam varies with height, shape, and thickness. Lastly, they will test, evaluate, and revise their beams using feedback from testing to refine their designs.

Learning Goals

Students will:

1) Describe forces that act on structures.
2) Explain how the size and shape of a beam will affect the ability to resist loads.
3) Calculate the efficiency of a constructed beam.
4) Design, construct, and test a variety of beams to determine which can support the most weight.

Transportation: Across the United States

Summary Of Unit

In this unit students will explore transportation technology by understanding transportation environments (land, water, air, and space) and transportation systems. They will be able to experience how ideas for inventions and innovations are modeled and recognize how transportation has played an important role in the development of the United States.

Learning Goals

Students will:

1) Explain the significance of transportation in the westward expansion of the United States.
2) Describe how inventions and innovations in technology can be modeled.
3) Recognize that transportation systems are comprised of several subsystems.
4) Design, construct, and test a prototype of a transportation vehicle by following the Engineering Design Process.

Communication: From Print to Radio

Summary Of Unit

Few things have changed our world as drastically as communication technologies, such as the telephone and television. They have changed our homes, our workplaces, and our buying choices. Designing, creating, and producing commercials will show students how to work within the communications environment to create a unique and appealing commercial, or advertisement, to promote school spirit.

In this unit students will explore communication processes and mediums by designing, developing, and implementing different types of commercial projects promoting school spirit. In teams of three or four, students will create an advertising firm. Each team will create an identity for their firm and meet their school's advertising needs in order to encourage students to support their school and show school spirit.

Learning Goals

Students will:

1) Describe how to assess the design of technological products by asking good questions.
2) Explain the concepts of risks, benefits, and trade-offs.
3) Use the findings of an inquiry process to design and produce an improved school bag by following an engineering design process.

Power and Energy: The Wizards of Willing Wind

Summary of Unit

This unit presents an alternative form of energy that is both available and inexhaustible. Students will construct a device that will capture wind energy and convert it into mechanical energy. The students will also design and build a structure that will support their wind energy device. The students will research and compare the energy cycles of the most common resources used to produce electricity in an attempt to gain an understanding of how those systems work. The students will also examine the ways energy is used for technological devices in their home.

Learning Goals
Students will:

1) Explain how energy is created, transmitted, and utilized in a home.
2) Describe benefits and drawbacks of utilizing renewable energy.
3) Design and develop a device that will harness wind and convert it into mechanical energy.

Inquiry: The Ultimate School Bag

Summary of Unit:

In this unit the students assume the role of design engineers for a company called Sensible School Supplies. They will use inquiry skills to investigate and evaluate the school bags they currently use and apply what they discover to design and construct a model of their version of the ultimate school bag. The students will then present their school bag designs to students from other classes.

Learning Goals:
Students will:

1) Learn to assess the design of technological products and systems.
2) Understand the concepts of risk, benefits, and trade-offs.
3) Use the findings of an inquiry process to design and produce an improved product by following an engineering design process.
4) Recognize the widespread use of technology in our society.

Technological Systems: Creating Mechanical Motion

Summary of Unit:

In this unit, students will explore simple machines and linkage mechanisms. After seeing what these can accomplish, students will be challenged to design a toy that uses both to create movement. Since everyone thinks of toys and games as fun, this is an ideal medium for learning. As students turn their ideas into models, learning occurs. Students will design, build, test and make improvements to their designs.

Learning Goals:
Students will:

1) Explain mechanical linkage function and movement.
2) Explain how the Engineering Design Process is used when creating mechanical devices.
3) Recognize that simple machines can be used with linkage mechanisms to create a mechanical system.

Design: Toying with Technology

Summary of Unit:

This unit will show students how they take an idea from brainstorming to sketching to prototyping. Students will see how creative designs, unique logos, vivid color schemes, and celebrity endorsements can affect how many people may buy, sell, and play with board games. Students will explore two-dimensional (2-D) and three-dimensional (3-D) visualization processes and mediums by designing, developing, and building a board game. Students will design and create a game for the Happyland Toy Company, a fictitious board game company.

Learning Goals:
Students will:

1) Describe and demonstrate how visualization and drawing techniques are used to document ideas using two- and three-dimensional representations.
2) Explain how the engineering design process may be used to develop a new product such as a game.
3) Recognize that effective marketing techniques can increase product success.