Invention, Innovation, Inquiry (I³)

Units for Technological Literacy, Grades 5-6

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Jean Piaget

“"If you want to be more creative, stay in part a child, with the creativity and invention that characterizes children before they are deformed by adult society."
Thomas A. Edison

- "Just because something doesn't do what you planned it to do doesn't mean it's useless."
- "To invent, you need a good imagination and a pile of junk."
Edward de Bono

“Creative thinking is not a talent, it is a skill that can be learnt. It empowers people by adding strength to their natural abilities which improves teamwork, productivity, and where appropriate profits.”
Dawn Glover

- “Innovation = revolution not evolution”
Gary Hammel and Gary Getz

“A company can’t outgrow its competitors unless it can out innovate them.”
Alexander Graham Bell

- “When one door closes another door opens; but we often look so long and so regretfully, upon the closed door that we do not see the ones which open for us.”
Peter Drucker

- "Every organization needs one core competence -- innovation."
- 1 – Inventor/Innovator
- 10 – Designer
- 100 – Developer
- 1000 – Developer/Manager
- 10,000 – Manager
Websites

- http://inventors.about.com/
- http://www.kyrene.k12.az.us/schools/brisas/sunda/inventor/quotes.htm
- www.askjeeves.com
Technology is:

- The innovation, change, or modification of the natural environment to satisfy perceived human needs and wants.
  
  Standards for Technological Literacy, ITEA, 2000

- The *process* of *designing* and *making* things by using machines, materials, and knowledge to *solve* practical problems.
Technological Change
## Technology Education & Educational Technology

**Technology Education**
- (Technological Studies)
- Teaches about technology
- A school subject
- Ultimate goal: Technological literacy for everyone

**Educational Technology**
- (Instructional Technology)
- Teaches with technology
- A means of teaching
- Ultimate goal: Improving the process of teaching and learning

“...many people believe that their schools already teach about technology, when in reality they teach only about computers.”

*Technically Speaking*, National Academy Press, 2002
Technological Literacy

The Ability to Use, Manage, Understand, and Assess Technology
Dimensions of Technological Literacy

Technologically Speaking, National Academy Press, 2002

Technological Literacy Includes:
- Capabilities
- Knowledge
- Ways of Thinking and Acting
Traits of a technologically literate person

- Are familiar with basic concepts of technology
- Can use a problem solving/engineering design process to solve technological challenges
- Knows that technology shapes society and in turn society shapes the development of technology
- Understands that using technology entails risk
- Recognizes that all technology has benefits and costs & is neither good nor bad
- Has hands-on capabilities with common technologies
- Realizes that there is no perfect design
Standards for the Study of Technology

- Standards for Technological Literacy: Content for the Study of Technology
The Nature of Technology

- The characteristics and scope of technology
- The core concepts of technology
- The relationships among technologies and the connections between technology and other fields of study

Technology and Society

- The cultural, social, economic, and political effects of technology
- The effects of technology on the environment
- The role of society in the development and use of technology
- The influence of technology on history

Design

- The attributes of design
- Engineering design
- The role of troubleshooting, research and development, invention and innovation, and experimentation in problem solving
Standards

Abilities for A Technological World

- Apply the design process
- Use and maintain technological products and systems
- Assess the impact of products and systems

The Designed World

- Medical technologies
- Agricultural and related biotechnologies
- Energy and power technologies
- Information and communication technologies
- Transportation technologies
- Manufacturing technologies
- Construction technologies
Overview of I³

- Funded by the National Science Foundation
- Implemented by ITEA and California University of Pennsylvania
- 2 year grant – renewed to 4 years
- Current Status – Middle of year 5 (extension)
- Award Amount - $995,036
Unit Development Process

- Unit Development
  - Writers Team Meeting
  - Unit Conceptual Framework (UBD)
  - Teacher’s Meeting
  - Writer Peer Review

- Unit Review Process
  - PI & Editor Review
  - Expert Team Review
    - Science
    - Mathematics
    - Engineering

- Unit Testing Process
  - Piloting Testing (2-3 sites)
    - Initial Review
    - Site Visit/Interview
    - Final Review
    - Focus Groups
    - Small Groups
  - Review & Edit
  - Field Testing (4-5 sites)
  - Review & Edit

- Field Test Phase 2
- Dissemination – Fall 2006
Project Goals

- Create a model for standards-based instructional units addressing the study of technology and science to be implemented in grades 5 or 6.
- Align contemporary classroom/laboratory instruction with technological literacy and science education standards and with connections to mathematics standards.
- Pilot and assess the model in diverse classroom/laboratory environments.
- Disseminate resources with professional development support.
Goal #1

- Create a model for standards-based instructional units addressing the study of technology and science to be implemented in grades 5 or 6.

**Objectives:**

- Develop units using a conceptual framework based on current research, Technological Literacy Standards, and National Science Education Standards.
- Identify learning goals for each unit that reflect the conceptual framework.
- Cite standards and benchmarks to be addressed in each unit module.
- Develop an assessment component for each unit.
Goal #2

- Align contemporary classroom/laboratory instruction with technological literacy and science education standards and with connections to mathematics standards.

Objectives:
- Incorporate contemporary instructional strategies for implementing units.
- Integrate math standards with technology and science content.
- Develop teacher support materials for content, contemporary approaches, contextual applications, and assessment.
- Develop classroom resources for implementing the units in diverse settings.
- Identify appropriate student assessment strategies for each unit.
Goal #3

• Pilot and assess the model in diverse classroom/laboratory environments.

• Objectives:
  – Pilot the units in eight states and in different local environments.
  – Assess teaching and learning as a result of using the proposed units.
  – Use assessment results to revise the units for greater effectiveness.
Goal #4

- Disseminate resources with professional development support.

**Objectives:**

- Distribute materials nationally in CD and hard copy format.
- Develop and implement web-based support resources.
- Conduct teacher workshops at national professional conferences and at local sites.
Summary

This unit is about innovation, measurement, and anthropometrics, 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:
- Demonstrate an understanding of basic design concepts as they relate to measurement and human form.
- Explain and demonstrate how an engineering design process can be used to improve technological devices.
- Describe limitations for a given device or design.
- Realize that with innovation, technological devices can be improved in many different ways.
Background for the Teacher

- Provides a 4-5 page overview of the content.
- Gives examples that can be shared in class.
- May be duplicated for student reading.
Other Resources

- Key terms
- Website
- Print Material
- Video References

**Key Terms**

- Anthropometrics: Study of the human form as it relates to product design. This is commonly used when designing such things as shoes, hats, chairs, cars, and snowboards.
- Design: Taking ideas you develop in your mind and putting them on paper as drawings, words, or sketches.
- Discovery: New knowledge created through the process of inquiry. The discovery of electricity by Benjamin Franklin revolutionized our world.
- Innovation: An improvement of an existing technological product, system, or method of doing something.
- Inquiry: A process which people use to study the natural world and develop knowledge and understanding of scientific ideas.
- Invention: A new product, system, or process that has never existed before, created by study.
Implementing the Unit

- Getting Ready
- Tools and Materials
- Conducting the Unit
- Extending the Unit
- Assessing the Unit
- Message to the Parents
- Transparency Masters
Student Material

- Handouts
- Worksheets
- Design Activities
- Design Packet

Getting a Handle on Anthropometrics

Name: ____________________________ Class: ____________

Anthropometrics is the measurement of human form. This is commonly used when designing such things as shoes, hats, chairs, cars, and snowboards. Many times people use their hand to estimate the size of something. In this activity you will be measuring your hand and then using the measurements to estimate the size of various objects. Therefore it is important to measure accurately and double-check your sizes.

Read each of the descriptions below. Measure the items as indicated. Write down the size for each hand.
Engineering Design Process

Identify a Challenge

Explore Ideas

Plan & Develop

Test & Evaluate

Present the Solution
Design Packet

- Each section aligns with the steps of the Engineering Design Process
- Student Ready for duplication
- Assessments Included
Invention: The Invention Crusade

Students develop an idea into an invention by designing and constructing a working model or prototype of a gadget that helps a small child to do a household task.

Pilot: Spring 2002
Field: Fall 2003
Innovation: Inches, Feet and Hands

Students use the engineering design process to design and develop an improved product that is used by the human hand.

Pilot: Spring 2002
Field: Fall 2003
Manufacturing: The Fudgeville Crisis!

Students explore food preservation and packaging as their companies mass-produce and package “fudge” for a Fudge Festival.

Pilot: Fall 2003
Field: Spring 2004
Communication: From Print to Radio

Students examine communication processes and mediums by designing, developing, and implementing different types of commercial projects promoting school spirit.

Pilot: Fall 2003
Field: Spring 2004
Construction: Beaming Support

Students act as a structural engineer and design and construct at least two laminated paper beams, testing, evaluating, and redesigning their beams for maximum strength.

Pilot: Fall 2003
Field: Spring 2004
Transportation: Across the United States

Students investigate the systems of transportation and how transportation has impacted the United States and then apply their learning by designing a transportation vehicle.
Power and Energy: The Whispers of Willing Wind

Students gain an understanding of wind energy and power as they construct a device that captures wind energy and converts it to rotational energy.

Pilot: Spring 2004
Field: Fall 2004
Design: Toying with Technology

Students explore two-dimensional (2-D) and three-dimensional (3-D) visualization processes and mediums by designing, developing, and building toys that solve a given problem.

Pilot: Spring 2004
Field: Fall 2004
Inquiry: The Ultimate School Bag

Students use inquiry skills to redesign a school bag and construct a model of the “Ultimate School Bag.”
Students investigate two mechanical devices, pneumatics and linkage mechanisms, and design a toy that uses both to create movement.
Hands-on Workshop

- Your chance to try 2 of the ten units.
- Work as if you were a student in 5th or 6th grade student.
- Consider ways that these units will develop basic technological literacy skills and knowledge.
What teachers have said:

- “Students were able to work across the curriculum with the integration of other subject areas.”
- “Students are led to analyze the world and tasks around them, seeking problems to be solved – giving them increased awareness of others and boosting their personal sense of efficacy.”
- “It is a great unit! The hands-on along with the critical thinking skills the students develop will be used in other areas. I hope to connect this unit with every aspect of their learning.”
- “One of the greatest benefits of the I³ unit for my students was getting excited, interested and imaginative about a school assignment.”
- “Students learned to be more like a scientist with note taking, testing, and interacting with each other.”
What students have said:

- “This step-box has good deflection.”
- “I get to...learn more than just what is taught”
- “I would much rather work in teams than individually”
- I can “let my ideas be heard and be more creative”
- I like when “math is open-ended and not just right or wrong”
- “I had to think and put together all the stuff I learned in other classes”
- I can put science and history together, and I think it is neat”
I³ Findings (so far…)

- Students develop better thinking skills
- Students work actively and document their thinking and designing in a journal or portfolio
- Students enjoy the challenge to think
- Teachers, with no previous experience in technology education, find the units easy to follow
- Units show integration of many subject areas
- Improved design skills
- Students stay focused on task longer
Unit Packaging

- Invention: The Invention Crusade
- Transportation: Across the United States
- Inquiry: The Ultimate School Bag
- Communication: Communicating School Spirit
- Innovation: Inches, Feet, and Hands
- Power and Energy: The whispers of a willing wind
- Design: Toying with Technology
- Technological Systems: Creating Mechanical Toys
- Manufacturing: The Fudgeville Crisis
- Construction: Beaming Support
Discussion and Questions
For More Information:

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