Web Unit Plan

Title: Help Wanted, Physicist

Description: Lobby Congress! Influence policy! Student teams for special interests lobby various groups in order to investigate and weigh the outcomes from modern physics research. Topics students study may include plasma physics, fusion, superconductivity, lasers, optical engineering, condensed matter, quantum teleportation, and biophysics.

At a Glance

Grade Level: 11-12

Subject sort (for Web site index): Science

Subject(s): Applied Physics

Topics: Current Affairs, Science in Society, Economics

Higher-Order Thinking Skills: Analysis, Argumentation

Key Learnings: Ethics, Persuasion, Government

Time Needed: 3 weeks, 15 hours in class

Background: From the Classroom in Washington, United States

Unit Summary

Students study current topics of physics research and consider potential social and economic implications for the world at large. Students form collaborative teams and select an area of physics research to investigate. They collect information summarizing current research and issues related to their topic, biographical information on scientists who work in the field, and information on possible effects this area of research could have on mankind. Students represent informed experts who present their findings to a Senate subcommittee, taking a point of view about the risk or benefit of the research endeavor.

Curriculum-Framing Questions

- **Essential Question**

  Just because we can, should we?

- **Unit Questions**

  How do scientific breakthroughs affect our lives?

  Why should the general public be aware of scientific breakthroughs?

  How have scientific discoveries been misused in the past?

- **Content Questions**

  What scientific discoveries are currently being developed?

Assessment Processes

View how a variety of student-centered assessments are used in the Help Wanted, Physicist Unit Plan. These assessments help students and teachers set goals; monitor student progress; provide feedback; assess thinking, processes, performances, and products; and reflect on learning throughout the learning cycle.

Instructional Procedures

Introduction

Initiate a short discussion around the Essential Question, *Just because we can, should we?* View the film *The Atomic Café*. Use the story of the atomic bomb to examine and discuss whether it was ultimately a detriment or benefit to mankind. Broaden the discussion to the impact of other physics-based technology and developments on the world. Discuss the Unit Question, *How have scientific discoveries been misused in the past?*

Research

Introduce to students the following scenario:

> As a member of a team of expert physicists, you have been contracted to support a special interest lobby group. A bill has been introduced to Congress that will give $1 billion to support current physics research. Decide whether your team is for or against a specific topic of research that will be supported by the bill. You must prepare to persuade others to support your point of view. Be sure to identify and refute possible counterarguments.

Hold a discussion with students focusing on the Unit Question, *How do scientific breakthroughs affect our lives?* Brainstorm answers and post them on butcher paper around the room. Have students form collaborative teams and select a current topic in an area of physics research for investigation. Introduce the slideshow to set the stage for the investigation. In teams of three to four, have students use the Internet, text sources (books, journals, encyclopedias, and so forth), and CD-ROM resources to research a selected area currently being researched by physicists. Distribute the unit's set of research links to help students get started. Areas of study may include but are not limited to plasma physics, fusion, superconductivity, lasers, optical engineering, speed of light, condensed matter, quantum teleportation, biophysics, and chaos. Suggest these topics to students, but let them know they may generate other topics for consideration. Ask groups to use a planning sheet to gather all basic information about their topics, including relevant physics, information about the purpose of research, and potential or real benefits or risks associated with the area of study.

Presenting Research—Student Multimedia Presentation

After gathering information, ask students to synthesize their findings in a collaborative multimedia presentation. Hand out the presentation scoring guide and discuss project expectations. Make sure students understand that they will present a summary of current information about their topic, biographical information of two scientists connected to their topic, and information that answers, *How do scientific breakthroughs affect our lives?* by discussing potential benefits and dangers associated with the topic. The presentation also includes a works cited page. Show a sample student slideshow before students develop their own. Distribute the student presentation checklist to help guide student work.

Ask students to practice their presentations before a small group of their peers. Using the presentation scoring guide, have the observers take notes during the presentations. Ask observers to complete the peer feedback form. Then schedule group conferences so that the presenters can receive feedback on their

presentations. Allow time for students to revise presentations and then have each group present to the entire class.

Following the presentation, ask students to lead a discussion on the issues raised, focusing on the Essential Question, *Just because we can, should we?* Incorporate whether the research should be continued, and the potential costs and benefits of research in the area of physics. Assess student presentations using the presentation scoring guide.

Persuading Others—Student Newsletter

In the next project, tell students that they will develop and support a point of view about their topic. They must analyze current and future consequences of development in their field of research. After careful analysis and debate, ask students to decide whether to support or oppose congressional funding and document their findings and recommendations in a newsletter. Their job is to convince others to either support or fight the funding for the bill. Show a newsletter sample before students begin and pass out the newsletter scoring guide. Discuss project expectations and check for student understanding before students begin their work. Have students use the newsletter scoring guide as a guide for developing their argument and newsletter, and use it to assess students' final projects.

Have students use the collaboration rubric to asses each other's contributions in each of the projects completed. Use this rubric along with the project scoring guides to assess student learning.

Optional Student Web Page

Give students the option to complete a Web page project. This can include background information about the physics topic, an online quiz for visitors, a response page (for visitor feedback), a works cited page, and a links page.

As closure for the unit, have students write a short individual essay that answers the Essential Question, *Just because we can, should we?* Students must use evidence from the presentations they saw to support their answers. Use NWREL's 6 Traits writing rubric to assess student essays.

Prerequisite Skills

- Intermediate skills using slideshow and publishing applications (or set aside time for training students in the use of these tools)
- Ability to locate information in print and electronic sources
- Ability to work collaboratively with other students

Differentiated Instruction

Resource Student

- Buddy up the student with a peer coach
- Allow more time to finish products, or reduce requirements
- Enlist help from support personnel and school volunteers

Gifted Student

- Encourage the student to research more advanced or theoretical topics

- Encourage advanced slideshow work, such as including hyperlinks and creating a nonlinear presentation
- Encourage the student to create custom graphics
- Have the student act as an assistant teacher
- Have the student correspond with and interview researchers/scientists

English Language Learner

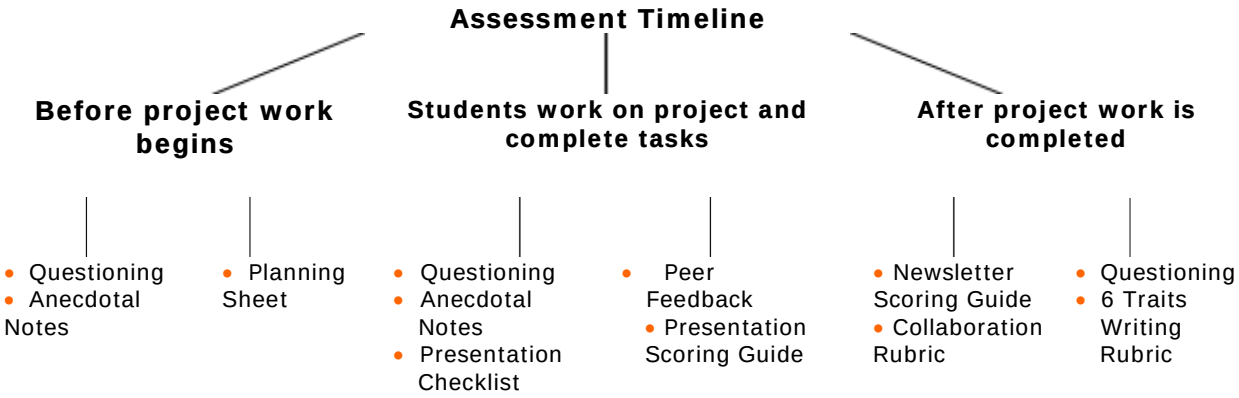
- Have the ELL teacher explain difficult concepts and help the student complete assignments and conduct research
- Pair a bilingual student with the ELL student for tasks that require reading and writing
- Adapt assignments, or allow more time as necessary

Credits

Gregory S. Burkhart participated in the Intel® Teach Program, which resulted in this idea for a classroom project. A team of teachers expanded the plan into the example you see here.

THINGS YOU NEED (highlight box)

Assessment Plan



Use questioning and anecdotal notes throughout the class discussions to informally assess student learning and redirect teaching if needed. Students use the research planning document to help guide the research process. The presentation checklist guides students in the creation of their presentations, and the presentation scoring guide is used to assess students' multimedia presentations. Students participate in peer conferences to receive feedback on their presentations. They use this feedback to strengthen their presentations before the final presentation. Use the newsletter scoring guide to assess students' newsletters. Students use a collaboration rubric to self-assess their collaboration skills during all of the projects. Assess the individual essay using NWREL's 6 Traits writing rubric.

Content Standards and Objectives

Targeted Washington Content Standards and Benchmarks

Science: Essential Academic Learning Standards:

- Apply science knowledge and skills to solve problems or meet challenges: Study and analyze challenges or problems from local, regional, national, or global contexts in which science/technology can be or has been used to design a solution.
- Know that science and technology are human endeavors, interrelated to each other, to society, and to the workplace:
    1. Analyze how scientific knowledge and technological advances discovered and developed by individuals and communities in all cultures of the world contribute to changes in societies.
    2. Investigate the scientific, mathematical, and technological knowledge, training, and experience needed for occupational/career areas of interest

Student Objectives

Students will be able to:

- Work collaboratively to research one topic of modern physics
- Develop a thorough presentation and teach peers, aided by a slideshow
- Describe a topic and research methods in adequate detail
- Present biographical information about researchers
- Illustrate how a physics topic connects to human needs
- Compare and contrast potential benefits and drawbacks related to specific research
- Develop awareness of current physics research topics
- Develop a persuasive argument to support or discourage research related to a topic, and present work in a brochure

Materials and Resources

Printed Materials

- Berns, M. W. (1998). Laser scissors and tweezers. *Scientific American,* 278, 62-67.

Internet Resources

Fusion Articles

- Carpenter, C. (2001). *Fusion basics*. Oxfordshire, UK: European Fusion Development Agreement. Retrieved from www.jet.efda.org*
- Coon, R., Leuer, J., & Rick, L. (2000). *Educational Web site: Fusion energy*. San Diego, CA: General Atomics. Retrieved from: http://fusioned.gat.com*
- Phillips, C. (2000). *Fusion basics.* Princeton, NJ: Princeton University, Princeton Physics Plasma Laboratory. Retrieved from www.pppl.gov*

- Wesson, J. (2000). *The science of JET*. Oxfordshire, UK: European Fusion Development Agreement. Retrieved from www.jet.efda.org*

Lasers

- Lasers
  http://members.aol.com/jimb3d/lasers.html*
  Books about different types of lasers
- Schawlow and Townes Invent the Laser
  www.bell-labs.com/history/laser*
  Information about the invention of the laser

Superconductivity

- DOE Energy Efficiency and Renewable Energy (EERE): Superconductivity
  www.eere.energy.gov/EE/power_superconductivity.html*
  Information about how a superconducting power system could meet the growing demand for electricity
- Superconductor Information for the Beginner
  http://superconductors.org*
  The basics of superconductors

Quantum Teleportation

- Quantum Teleportation
  www.research.ibm.com/quantuminfo/teleportation*
  An explanation of teleportation - Teleportation is the name given by science fiction writers to the feat of making an object or person disintegrate in one place while a perfect replica appears somewhere else
- Scientific American: "Beam Me Up"
  www.sciam.com/article.cfm?articleID=00014CBD-7633-1C76-9B81809EC588EF21&ref=sciam*
  Research on teleportation

Fusion

- General Atomics Fusion Education
  http://fusioned.gat.com*
  Fusion information and activities for the classroom
- National Fusion Energy Science
  www.fusionscience.org*
  Articles about fusion
- Princeton Plasma Physics Laboratory: Fusion Basics
  www.pppl.gov/fusion_basics/pages/fusion_basics.html*
  The basics of fusion

Plasma Physics

- Plasma on the Internet
  http://plasma-gate.weizmann.ac.il/PlasmaI.html*
  Links to plasma Web sites
- Perspectives on Plasma
  www.plasmas.org*
- The Plasma Universe
  http://plasma.lanl.gov*
  The Web site explores all aspects of plasma science and technology

Biophysics

- University of Minnesota Department of Biological Physics
  www.physics.umn.edu/research/biological.html*
  Information about biological physics

Chaos

- In a World of Order… Chaos Reigns
  http://library.thinkquest.org/3120*
  Explores the basic principles behind the chaos theory and demonstrate their use in everyday life

Rubrics

- Northwest Regional Educational Laboratory: Six Trait Writing
  www.nwrel.org/assessment/scoring.php*

Other Resources

- Loader, J. (Director). (1933). *The atomic café.* [VHS/DVD]. New York: First Run Features.

Technology—Hardware

- Computer(s) for conducting research and creating products
- Internet connection for conducting research
- Printer to print materials for presentations
- Projection system for presentations
- Television to view *The Atomic Café* video
- VCR to view *The Atomic Café* video

Technology—Software

- Desktop publishing for newsletter
- E-mail application to e-mail experts in the field
- Encyclopedia on CD-ROM for conducting research
- Image processing to manipulate pictures that are part of the products
- Internet web browser for conducting research
- Multimedia to create presentations
- Web page development to create Web pages
- Word processing to take notes for research