PBIS PROJECT PLANNER*

*Modeled after and adapted from Vermont secondary PROJECT Science Partnership and Buck Institute for Education (www.bie.org/)

VISION: To understand nuclear physics through the study of the impact on our society and world.

Teacher(s): University of Vermont Department of Education

Project Title: Science and Society: Exploring the Role of Nuclear Physics on the World (modified from a lesson written by UVM Noyce Scholar, Heather Cutler)

Grade Level(s): 7-12

Subject(s): How can you incorporate **interdisciplinary subjects** into this project design?

- ✧ Coordinate with **humanities** and **art** instructors to look at the **social justice, history,** and **art** surrounding **nuclear physics**.
- ✧ Consider creating some sort of **art for social change** project.
- ✧ Connect with the **librarian** and **media specialist** or **journalist** to further explore the topics.

Timeframe: From 1 week - 1 month, depending on student interest

Big Ideas/Enduring Understandings: What big ideas or real-world dilemma will drive this project?

- ✧ Politics, power, voice: science and society are inextricably interwoven.
  - Whose voices matter science?
  - Whose voices matter society?
- ✧ Social stigmas have dictated who was published in science and how accessible certain fields are/were to certain people.
  - Has nuclear science excluded certain groups/individuals?
  - There were specific individuals selected to develop the field of nuclear physics. Who were they and why were they selected?
  - What is the best way to decide who gets to practice science, or who gets credit for discoveries?
  - Why were there so few women and people of color involved in the Manhattan project?
- ✧ What is nuclear physics?
  - **History**: What is the **history** nuclear physics?
  - What were the main events in nuclear physics history?
  - Whose stories get preserved? Told? Why?
- ✧ What are the benefits and ramifications of an advanced nuclear physics program?
  - Who are the stakeholders impacted by nuclear physics and what do they have to say? Do they have voice?
  - Are there people who benefit or are harmed by their voice/lack of voice?

Essential Questions: What essential questions will drive the project?

Consider the themes that will focus the unit and ones that integrate social justice issues (preferably local ones/issues that are meaningful to student audience). NOTE: This is a great activity to do with your students but it is usually helpful to already have some ideas in the hopper

Essential Social Justice Questions

- ✧ How does society influence science?
- ✧ How does science influence society?
- ✧ What implications do social standards have on *who* is involved in science and *what* is studied and *how* was/is the study of/development of nuclear physics funded?
- ✧ Where is nuclear physics today? How did we get there?
- ✧ How do the ideas we have talked about in a historical context apply to today? Is science today different than it was in the 1940's? Is it "fair"?

Overall Nuclear Physics Questions

- ✧ Where are nuclear physical reactions and how do they work?
- ✧ How did scientists come to understand nuclear physics and what sorts of experiments/reactions did they carry out?
  - What materials/equipment were needed in order to accomplish this?
  - How was this endeavor funded?
  - Is it "fair" or "right" to allocate funds to scientists who are designing weapons that will harm other people?

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<table>
<tr><th colspan="3">KNOWLEDGE AND SKILLS: What key knowledge and skills will students acquire as a result of this unit?</th></tr>
<tr><th>Content & Concepts:
What will Students know or need to know?</th><th>Skills:
What skills will students need or need to acquire?</th><th>Standards Addressed</th></tr>
<tr><td>✧ Describe how a neutron can give energy to a nucleus and cause it to fission.
✧ Explain the byproducts of a fission event and give examples from history.
✧ Explain how a chain reaction works and describe the requirements for a sustained chain reaction large enough to make a bomb.
✧ Explain how a nuclear reactor works and how control rods can be used to slow down the reaction.
✧ Terminology of nuclear physics and social justice (e.g. fission, chain reaction, alpha radiation, plutonium, uranium, containment vessels, social status, hierarchy, privilege, status quo, etc.).</td><td>✧ Conducting labs and thinking like scientists in order to understand the content/concepts in nuclear physics; engage in the scientific process (hypothesizing, experimenting and design, analysis, presenting, and, as Einstein said, “act”.)
✧ Deciphering and presenting information to various stakeholders from officials to community members.
✧ Determining the accuracy and level of bias in the information researched and presented.
✧ Understanding personal levels of status and privilege and how that informs/alters one’s work in science and society.</td><td rowspan="3">USA- NAS- Science Education Standards National Academy of Science Content Standard G: SCIENCE AS A HUMAN ENDEAVOR
Fundamental Concept and Principle: Scientists are influenced by societal, cultural, and personal beliefs and ways of viewing the world. Science is not separate from society but rather science is a part of society.

Next Generation Science Standards
HS-PS1-1:Use the periodic table as a model to predict the relative properties of elements based on the patterns of electrons in the outermost energy level of atoms.

HS-PS1-8: Develop models to illustrate the changes in the composition of the nucleus of the atom and the energy released during the processes of fission, fusion, and radioactive decay

HS-PS2-6: Communicate scientific and technical information about why the molecular-level structure is important in the functioning of designed materials.</td></tr>
<tr><th colspan="2">Any additional concepts or ideas that may not be the focus but are worth being familiar with.</th></tr>
<tr><td colspan="2">✧ Exploring the connection between nuclear science and society
✧ Ethics of science—who decides what gets funded to study and why? Is this acceptable?
✧ How was the bomb conceived of and made?
o Where did this happen and what was required to make it happen (knowledge, resources, etc.)?
✧ Exploring the concept of privilege
✧ Who has it? What does it take to get it? What happens to people who do not have it?
✧ How is education a form of privilege?
✧ How does science fit into this equation?
✧ What are our responsibilities as educated members of this community who have access to knowledge and resources?
✧ Exploring techniques for handling information
✧ What are ways to stay organized?
✧ How can we maintain confidentiality and grace around sensitive, politically charged issues?
✧ How do we understand bias and accuracy in sources?
✧ What if this makes me feel uncomfortable—how should I handle myself?
✧ Exploring techniques for collaboration
✧ What if peers/community member have different opinions, work ethics, ideas and approaches?
✧ What if I struggle with my partner/group?</td></tr>
</table>

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INQUIRY: What is the desired result and how will students know when they have reached it? What is acceptable evidence?	
ASSESSMENT/PERFORMANCE TASKS: What is relevant assessment that will be useful to the stakeholders/problem identified?	**Other Evidence** that can be **Assessed**
What useful data, measurements, survey information, etc. might be helpful to the cause? How will you help students generate realistic, challenging, relevant final projects? ✧ Where are students starting from? Begin with an formative assessment of **prior knowledge** by starting with a photo essay and/or short audio/video clip and having students write thoughts and comments on post-it notes and debrief in pairs then as a group. Guiding questions: What do you know about that **atomic bomb**? What do you know about **nuclear physics**? o Secretly Working To Win The War In 'Atomic City' Audio Clip from NPR: http://www.npr.org/player/v2/mediaPlayer.html?action=1&t=1&islist=false&id=172908135&m=173350701 o The Moment in Time: The Manhattan Project Video: http://www.youtube.com/watch?v=xwpgmEvlRpM o Manhatten Project Voices: http://www.manhattanprojectvoices.org/oral-histories ✧ How familiar/comfortable are students with **unpacking social justice concepts**? Assess entry point for students—build from there. ✧ Students will be assessed on their: ✧ Nuclear physics **labs** ✧ Quality of participation in **mini-lectures**, and **on individual/group projects** ✧ **Reflections** on **articles**, **speakers**, **media**, and **interviews** ✧ Correspondence with a **scientist** who is currently working in the field of **nuclear physics** ✧ The quality **portfolio** organization in a **portfolio** ✧ The last 10 minutes of each lesson will be devoted to a **quiet time of writing/reflection**. Students will reflect on how society and science influence each other, particularly on what the science is used for and who is involved in it.	**Examples could include but are not limited to: challenge projects, problem solving tasks, lab design/write-ups, presentations/performances, cooperative group work, models, quizzes, tests, observations, dialogues, work samples/drafts, logs, data collected, self/peer assessments, interviews with experts, etc.** Students will **select** and **research** a historical figured involved with the Manhattan Project, either political or scientific. Options include but are not limited to: Niels Bohr, Enrico Fermi, Richard Feynman, Albert Einstein, Robert Oppenheimer, Maria Goeppert Mayer, Leona Woods, Elizabeth Riddle Graves, FDR, Howard Truman, and Leslie Richard Graves. NOTE: A good resource for a list of people involved is mphpa.org (http://www.atomicheritage.org/) and http://www.manhattanprojectvoices.org/oral-histories. Students will be responsible for **researching** their individual and the role that they played in the development of the atomic bomb. Together with the students, we will create a **rubric** to assess our projects. Students will be asked to research the individual using the guiding questions below and compile a presentation about their individual. Students will **present** and **submit** (hand in) a compilation of the results of their research. This can be submitted in a variety of forms including but not limited to: a puppet show, a piece of art, dressing in character and giving an oral presentation, a song or poem, or an essay. Note: these suggestions are simply that—suggestions. Students may develop other creative ways to present their research. Following each student 10-15 minute presentation, we will have a class discussion, facilitated by students, focusing on the following questions: 1) How does science influence society and/or politics? 2) How do politics and/or society influence science? 3) Who can be involved in science? How is that determined?

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BUILD: How will the learning experiences be developed?

DESCRIBE THE PROJECT	CREATE BUY-IN

What is the background and context of the project? What is the relevancy and importance of the project? What is the authentic challenge/problem being addressed?
 	
✧ The FAA's house relocation program: students can look look into the history/background of this
  ✧ When did this program begin?
  ✧ Why did it start?
  ✧ Does it have bi-partisan support?
  ✧ What are their definitions, (e.g. of "loud")
  ✧ Why is it **relevant? Important? A challenge for our community?**
 	
Following the Chalk Talk, there will be a brief mini-lecture (<3 min) covering the following points
 	
• The atomic bomb was developed during WWII in the United States
• The project was rushed along because of a fear (rumor) that the Germans were close to a breakthrough on a massive weapon
• The project was called The Manhattan Project and it utilized a huge number of scientists in America
• Many scientists and laborers were not aware of specifically what they were working on
• There was a lot of controversy over whether or not to drop the bomb on Japan
	How can you hook your students? What would create buy-in? Who might they get involved with that is an expert in this field?
	
	✧ Start with a fieldtrip to the airport
	  ✧ Set up interviews with the various stakeholders or have a panel discussion
	  ✧ connect them with real people who are being negatively affected by the noise, the need to move, etc. <u>especially if they themselves are young people</u>
	  ✧ Involve the media
	  ✧ Listen to broadcasts and read lots and lots and lots articles with varied opinions
	  ✧ Dissect articles—explore how this one made you feel versus the other and *why* that was so

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Begin to design your project board: Outline specific tasks, milestones/timelines that students will complete early on, during, and at the end of the project. Who might they get involved with that is an expert in this field? Remember to emphasize problem posing, problem solving, and other meaningful tasks in the design.

BUILD, cont.

List preparations necessary to address needs for differentiated instruction: How this project meet everyone's needs?
(Remember to consider any ELL students, special-needs students, students with diverse learning styles, students who many struggle with reading and need varied levels, students who need clear expectations and scaffolding, students who need constant challenge, etc.)

List preparations for multicultural, socially-conscious classroom: How will *all* voices and points of view be heard with this project? How will the classroom promote the values of democracy?

List reflection and evaluation techniques: How will you and your students reflect on and evaluate the project? (E.g. Class discussion, Fishbowl, Student-facilitated formal debrief, individual evaluations or rubric work, peer/group evaluations, etc.) Develop a project rubric (or several mini-rubrics) that assesses the learning intentions for this project.

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CURRICULUM UNIT RESOURCES			
Student Literature	Classroom Materials	Web sites & Technology	Field Trips and Field Work
		http://phet.colorado.edu/en/simulation/nuclear-fission The Moment in Time: The Manhattan Project: http://www.youtube.com/watch?v=xwpgmEvlRpM http://www.ushistory.org/us/51f.asp nuclearweaponarchive.org/USA/Med/Med.html	

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PLAN LEARNING OPPORTUNITIES AND SEQUENCE INSTRUCTION		
Think about the different lessons/activities that will be needed to demonstrate the key knowledge and skills for this project. How will students work autonomously and build on their learning to ensure continual improvement?		
Week 1 - Dates:	Week2 - Dates:	Week 3 - Dates:
Week 4 - Dates:	Week 5 - Dates:	Week 6 - Dates:

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REFLECTION: Throughout and especially at the end of the project, consider what went well and what changes you would make for the next time.