



Lesson Title: Is Basic Science Important?

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Grade level: 7

Type of Lesson: STEM

Objective: To have students think about the importance of basic science and whether we should fund basic science with tax money. To help students to understand how all science is interconnected and the importance of science funding to science, culture, the economy and the future. Students will also practice skills dealing with controversy, debate and discussion.

Key Questions and Concepts:

- How does science fit into your life and future?
- How do we define basic science versus applied science.
- How does science-funding work in the US?
- Should basic science be funded?
- What are the pros and cons to funding basic science?
- How do science-funding decisions affect the future of science in the US?

Background Information: This lesson can be taught at any time, with many different levels of science students. It does not require any specific science background information or skills. It fits in well at the end of the year or semester after the students have been learning about science and perhaps learning about some research. It was the last lesson I taught in my GK-12 classroom and it followed lessons about my own research.

References:

“Why I study Duck Genitalia”, Patricia Brennan, SLATE, 4-2-2013

“What to Cut: As Congress treats crisis with new programs, government grows” Fox News, 3-25-2013

US government budget breakdown: <http://www.usgovernmentpending.com>

Vocabulary:

Basic Science: Study of science for the sake of science. Finding information that is not immediately useful to people. Usually public (university) and does not make a profit.

Applied Science: Applying science to practical human problems. Often private and typically makes a profit.

NSF: The National Science Foundation, one of several government science agencies that funds basic research in the US. This is what funds the GK-12 program.

Grant: Money that scientists apply for in a competitive process to pay for research.

Materials:

- Chalkboard, whiteboard or document camera to make class lists.
- Projector if you choose to use power point
- Students should use scientific notebooks or piece of paper.

Preparation: This lesson requires almost no prep time or set up. You could discuss proper debate etiquette before the lesson, if you do not want to take the time to discuss it during the lesson itself.

Safety Information: No specific safety guidelines.

Basic Lesson Plan:

1) **Survey:** Begin the class with a survey having the students raise their hands in response to the following questions. Call on some of them for each question to hear their thoughts:

- a. How many of you think you want to be scientists when you grow up?
- b. How many of you think you will do jobs that use science, like being a doctor or engineer?
- c. How many of you think science will benefit you in the future?
- d. How many of you are going to pay taxes in the future?

Make the point to the class that all of them are affected by science and are going to be paying for science. So in many different ways it is an issue that they should care about.

2) **Introduce the controversy:** there has recently been strong criticism in the US over the funding of basic science- as a waste of taxpayer dollars in a time of debt and recession. One scientist in particular who has come under fire (by Fox News) studies duck sex. She has been given \$400,000 from the National Science Foundation since 2005 for her research.

3) **Heat map:** Designate one side of the room as strongly agree, the other side as strongly disagree and then middle as a gradient between these two opinions. In response to the question: “Should the government fund basic research like the work of Patricia Brennen” have the students move to where their opinion falls. Call on several students from across the gradient to hear why they are standing where they are.

4) **Gather Information:** Have the students fill out a page in their notebooks with two columns: for and against. Have them come up with two reasons why the government should fund basic science and two reasons why the government should not fund basic

science. They then have to move around the classroom and fill out three more reasons in each column by talking to other students. They are only allowed to fill out one reason per student that they talk to.

5) **Class List:** Have the students generate a class list of “Reasons For” and “Reasons Against” on the board. Fill in anything important they have missed by prompting them to think of different things. Here is a list of just some of the reasons.

Example:

Reasons For	Reasons Against
<ul style="list-style-type: none"> • Keeps U.S. ahead in global economy, • U.S. should keep pace with other countries in scientific discoveries • The pure need to learn and understand our world • Basic research needs to be funded because there is no immediate profit • Moves science forward • “Useful” research is built upon basic research • Why do we value research that is helpful to humans, but not other life? • Small part of government budget • Grants process is reviewed and competitive • Keeps science discoveries public property. 	<ul style="list-style-type: none"> • Economic downturn • Government Debt • Waste of money • Pointless • Could be funding more important research • Politics

6) **More Information:** Take this time to explain to the students how the grant application process works and how scientists actually receive funding (competitive and peer reviewed). Also put up on the board statistics of government spending on science compared to other areas (military and so on). Give the students time to ask any questions they have.

6) **Debate:** Split the students randomly into two groups. Explain that they will have a debate over whether to use tax money to fund basic science. Assign each group one side of the argument and remind them of proper debate etiquette. Give each group time to think of their argument and come up with a strategy. Mediate a debate between the two sides- posing questions to keep discussion going, making sure different students answer in the groups. Half way through the debate switch the positions of the groups and make them argue for the other side.

Example questions:

Is it a waste of taxpayer dollars?

Is basic science important to the US?

How do you think this affects the world economy?

How will this decision affect the future?

Do you think Patricia Brennen's research in particular should be funded?

7) Examples from History: Gather the students back together and go through a short power point. The goal of this Powerpoint is to explain that basic and applied research are tightly interconnected- many advances in applied science happen because of what we learn in basic science. Science progress needs basic science. Take examples from history of what people at the time thought was pointless, or very pure science research that ended up being incredibly useful to science, healthcare and technology today.

Examples:

-Elizabeth H. Blackburn: pond scum and telomeres

-Osamu Shimomura: glowing jellyfish and GFP

-Thomas Hunt-Morgan: Fruit Fly Breeding and Chromosomes

-Joao Pedro de Magalhaes: naked mole rat and cancer resistance

Examples that relate specifically to what the students have been learning in class are great to include.

8) Heat-map: Again divide the room into a spectrum from strongly agree and strongly disagree and have the students move to a place in response to the question "should the government fund basic research." Have the students who changed position from the first heat-map raise their hands.

9) Wrap-up: Have a classroom discussion about how student's opinions have changed or stayed the same and what they have learned. Discuss how the issue is complex and why people are so divided in the US today. Begin within table groups and then go around the room and have the table groups share what they talked about.