Quiz 6

Name: Key

Practices for K–12 science classrooms (NRC 2012, p. 42).

Inquiry and design share the following practices:

1. Asking questions (for science) and defining problems (for engineering)
2. Developing and using models
3. Planning and carrying out investigations
4. Analyzing and interpreting data
5. Using mathematics and computational thinking
6. Constructing explanations (for science) and designing solutions (for engineering)
7. Engaging in argument from evidence
8. Obtaining, evaluating, & communicating information

1. When presenting a design problem to students is it valuable/important to show them *how* to solve the problem? Explain.

It is important to define ***what*** an acceptable solution will do without clarifying ***how***. If you show students how to built the final product, you will stifle their creativity and many of the important learning activities will be blocked. Students need room to be creative and they will not do that if they have seen a solution.

2. Do engineers define problems before they start a project? Explain.

Comprehending the design task is different from defining the problem. As engineers begin working on a task, they learn more about the situation and refine their ideas of where they are headed. Therefore it's quite common to not have a fully defined problem until well into or near the end of a project.

3. What are Design Criteria

Criteria are the <u>functions that the finished product must achieve</u>. Such as, a 4-lane bridge that will cross the Mississippi along I-70.

4. What are design constraints

The Constraints are the limits placed on the solution. For example: Time, money, available materials.

5. What are ways that models are used in science and engineering and how does the use differ between the two disciplines?

The use of models in science and engineering are very similar. In both cases they are creating a simpler or smaller version of a system or product. This smaller version is used to study the phenomena/product and to better understand the entire system/design. In both cases many models are created, each striving to improve on the previous version.

The difference is usually found in the end goal. In science models are used to understand systems so that predictions can be made. In engineering models are used to test prototypes.

6. Running multiple tests of your experiment is important in science. Is this also important in engineering? If so, explain why.

Yes. Testing prototypes is a very similar task to conducting scientific experiments. It's important to only change one variable at a time and run tests to learn how the variable affects the functionality of your prototype.

7. Is it better to aim for quantity of ideas or quality of an idea(s) when designing solutions or constructing explanations? Why?

Both. It's important to design more than one solution to explore the materials and different approaches. Quality is of course important because the prototype must perform a certain task. Building a bridge across the Mississippi that lasts one year, is not an acceptable solution! However, a good solution is not going to happen with the first prototype.

8. When discussing the pros and cons of various design solutions, what is the most common novice habit or misconception that students engage in?

Talking about only the cons of the solutions they do not like and talking about only the pros of the solutions that they do like. It's important to talk about the strengths and weaknesses of every design. This is a way to analyze more deeply and understand the constraints more thoroughly.

9. Are good designers also the best inventors? Why or why not?

Beginners often confuse engineering with inventing. An engineer does not have to invent a new kind of bridge every time a city needs a bridge built. Good engineers have learned from our previous experiences and often design solutions based only on what is already known about materials and physics. Most design tasks do not require an invention to come up with a great solution.

10. Discuss the support on the two mailboxes to the right. Which if either has a better support? Why?

The mailbox on the far right has the support centered under the weight of the box. This one post directly counters the force of gravity pulling down on the box. The left side mailbox has the support towards the back of the box. That means gravity is pulling down in a different place from the support. Without some other form of support, this box will easily tip forward. An angled piece under the front half of the box would help. Right now only the horizontal board under the box can help push up the front of the box but it's a weak way to provide upward support. In time this box will probably be tipping down at the front.

11. A book is resting on your desk. Consider the following forces:

    1. A downward force of gravity.
    2. An upward force exerted by the surface. Similar to the mailbox post holding the box up

Which of the above forces are acting on the book?

a. 1 only
b. 2 only
c. **Both 1 and 2**
d. Neither