

## Scientific and Engineering Practices Study Guide Key

### Scientific Inquiry

1. A controlled experiment is designed to ensure that all the variables (parts and conditions of the experiment) are tightly controlled and are kept exactly the same. The only exceptions are the **Independent** (or Manipulated) **Variable** and the **Dependent** (or Responding) **Variable**.
  - a. By controlling all the conditions of the experiment, the scientist is able to see the direct connection between the **Independent** and **Dependent Variables** (cause and effect).
2. All the variables in an experiment play a specific role, and each is different from one another. An experiment's success depends on these factors.
  - a. The **Independent Variable** is the part of the experiment that is purposely changed (manipulated). It is the "**cause**" variable, the "**before**."
    - **Ex.** The amount of water given to a plant
  - b. The **Dependent Variable** is the part of the experiment that **responds** to the change you made with the independent variable. This is the part of the experiment you would measure/record as data and study it. It is the "**effect**" variable, the "**after**."
    - **Ex.** The growth of the plant
  - c. The **Controlled Variables** are all the other parts of the experiment that must be kept exactly the **same (identical)** so that it doesn't affect the dependent variable.
    - **Ex.** The temperature of the water, the number of times the plant is watered, the same type of plant, the same type of soil, the same size flower pot, etc.
3. If you read a description of an experiment, would you be able to identify the independent, dependent variables and name all the variables that need to be controlled? This question is not one you can directly answer on this study guide, it was meant to make you think and self-evaluate your knowledge on this skill since this is how you will be primarily tested.
  - a. **Ex.** For Sam's science fair project, she needed to come up with a controlled experiment to study how plants respond to varying amounts of water. She asked her mom to help her. What would you tell her?
4. The scientific method is a process with important "steps" that need to be included, but there is not a single correct way to perform it. You could start at any "step" and still perform the inquiry with confidence and accuracy.
  - a. **Ex.** Starting with data collection during a controlled experiment.
    - Sam was performing her experiment and collecting data by measuring the height of her plants when she noticed that some of the plants were dying, in both the group (A) that got 2 times more water than the group (B). This led to a problem/question, which is a required step in the scientific method, usually the one listed first.

- b. How you begin and end with your inquiry depends on many factors such as; if your data collection shows no predictable patterns or trends, if there was human error, if scientists read a report and come up with a new idea, if technology changes or new information comes to light, etc. It is a fluid process that can evolve and change over time, therefore there isn't one proper way to perform an inquiry.

### **Engineering Design Practices**

1. Engineers help solve problems and design solutions to address the problem by identifying the criteria and constraints the problem poses.
2. Where science and engineering come together is when the scientists identify and study a scientific question or problem and bring it to the engineer. Then engineers research how to approach solving the problem and then plan and design that solution.
3. Collaboration is a big part of the engineering process. In general, it can happen anywhere in the process, but where it is used a lot is when they come together developing possible solutions through brainstorming and selecting the most optimal idea.
4. A prototype is a model of the chosen solution. By creating a prototype, engineers can test and evaluate how effective their solution/model is at solving the problem.
5. If your prototype design "fails" time and time again, then engineers need to redesign their prototype since it is not helping to solve the problem.

**Please Note:** Just answering the study guide questions will not be enough to prepare you for the test. Memorizing definitions and the study guide will only take you so far. The types of questions you will be asked will require you to **APPLY** your knowledge which challenge you to use higher level thinking like analyzing and evaluating information.