



Drexel-SDP GK-12 LESSON

Lesson: Scientific Method

Subject Area(s) Science and Technology

Associated Unit Science Fair Project

Lesson Title Fabrication Lesson: Space Station Remote Manipulator Arm

Grade Level 6 (5-8)

Lesson # 1 of 2

Lesson Dependency None.

Time Required 30 minutes

Summary

In this lesson, students will be introduced to the scientific (inquiry) process. The accompanying activity requires groups of students to practice what they have just learned, forming groups to conduct a scientific experiment.

Engineering Connection

Students will be using a microelectronic hand held device (Pasco Xplorer) for data collection during the activity phase of this lesson. It is emphasized to the students throughout this activity that engineers often design the tools that enable scientists to do their job faster, and with more accuracy. It is also emphasized to the students that very often engineers follow a "test-and-revise" process that is very similar to the scientific process.

Keywords

Experiment, hypothesis, inquiry, presentation, scientific process, science project

Educational Standards (PA)

- Science: Inquiry and Design 3.2: Process Knowledge (3.2.B) and Scientific Method (3.2.C)
- Math: Measurement and Estimation 2.3, Statistics and Data Analysis 2.6

Pre-Requisite Knowledge

Some prior experience in note-taking is preferred.

Learning Objectives

After this lesson, students should be able to:

- **Know the steps in the scientific process**
- **Know what's expected to be in a scientific notebook**

Introduction / Motivation

The question of “what happens if...” is the fundamental question of science inquiry as well as the engineering design process. Change one variable while the others remain the same, and there you have the basic formula for conducting experimental research. This lesson is intended to introduce you to the scientific inquiry method and to practice asking a question that you intend to answer yourself through experimentation. It may be that neither the teacher nor any other adult knows the answer to the research question, so that you will have the experience of teaching others. This lesson follows with an activity asking you to apply the method you will learn.

(In addition gaining familiarity with the scientific research process, there is an additional objective to have the students develop patience with their studies. Very often, students are given short assignments that take an hour or less to complete. With a science fair project, the timeline is stretched over weeks or even months. In addition, students will become familiar with keeping a scientific notebook to record and analyze experimental data.)

Lesson Background & Concepts for Teachers

Give an overview of the project and overarching objectives (practice asking a research question, perform the steps of the scientific inquiry process, learn to work in assigned groups, learn to keep a research notebook, learn to use electronic data collection equipment, and practice making an oral presentation).

Next present the steps to the scientific inquiry process. Cite each step along with an example from a science fair experiment. For example, use the Pasco Xplorer and the heart-rate sensor to test "Who has the faster heart rate in the 6th grade? Boys or girls?" Go through each step in the process below as it relates to the sample topic:

1. Define the problem. (We wish to study the human heart rate.)
2. Formulate a research question. (Who has the faster heart rate: boys or girls?)
3. State the hypothesis (We think girls have the faster heart rate because...)
4. Design an experiment. (We will use the Xplorer to measure the heart rates of three boys and three girls in the classroom and average the heart rate of each group to compare them.)
5. Collect data. (Make a table of the resting heart rates for the three girls and three boys and record the data on the blackboard)
6. Analyze data and draw conclusions (Review how to compute an average, then take the averages for the boys' and girls' heart rates. Conclude which is faster, and offer possible

explanations why, such as, the boys were more/less excited to participate in the demonstration, or two of the girls had just ingested some sugar, etc.).

7. Present the results (Demonstrate how to give a quick presentation of the results).

Vocabulary / Definitions

Word	Definition
Scientific Inquiry	The process by which scientists ask questions, develop and carry out investigations, make predictions, gather evidence, and propose explanations.
Research Question	The main question a scientific investigation aims to answer
Hypothesis	An educated guess for the outcome of the research question
Experiment	A procedure designed to test the hypothesis
Analysis	Evaluating and drawing conclusions based upon data collected
Quantitative Data	Numeric information that is measured.
Pasco Explorer	Electronic handheld data collection device

Associated Activities

Science Fair Activity

Lesson Closure

Follow with the Science Fair Activity, then the Science Fair Presentation Activity

Assessment

Lesson Summary Assessment

Ask to see the students' notebooks to ensure they have recorded the lesson notes. Then assign a short writing assignment where the children are to describe how they would go about investigating how much the temperature varies from day to night, or, some other question that requires the students to think through and plan an experimental procedure.

Lesson Extension Activities

Follow with the Science Fair Activity, then the Science Fair Presentation Activity

References

<http://www.pasco.com/labdownload> for ideas on experiments using the Pasco Explorer

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