**Concept Block One: Scientific Inquiry**

1. **In this section we will concentrate on the following standard and its components**:

**Standard: 5Sa: The student will demonstrate an understanding of scientific inquiry, including**

**the foundations of technological design and the processes, skills, and mathematical thinking necessary to conduct a controlled scientific investigation.**

**5Sa.1:** Identify questions suitable for generating a hypothesis.

**5Sa.2:** Identify independent (manipulated), dependent (responding), and controlled variables in

an experiment.

**5Sa.3:** Plan and conduct controlled scientific investigations, manipulating one variable at a time.

**5Sa.4:** Use appropriate tools and instruments (including a timing device and a 10x magnifier)

safely and accurately when conducting a controlled scientific investigation.

**5Sa.5:** Construct a line graph from recorded data with correct placement of independent

(manipulated) and dependent (responding) variables.

**5Sa.6:** Evaluate results of an investigation to formulate a valid conclusion based on evidence

and communicate the findings of the evaluation in oral or written form.

**5Sa.7:** Use a simple technological design process to develop a solution or a product,

communicating the design by using descriptions, models, and drawings.

**5Sa.8:** Use appropriate safety procedures when conducting investigations.

1. **These concepts correspond to the following sections in the Scott Foresman Textbook:**
2. xii- xvi, Using Scientific Methods for Science Inquiry
3. Any of the “Investigate Activity” sections spread throughout the text
4. **These concepts are encountered in the following *Reading Street* stories and articles:**
5. **Scientific Method (As Per Above):**
   * 1. Satchel Paige (Unit 1)
     2. Measuring Tornadoes (Unit 1)
     3. Wings for the King (Unit 3)
     4. Becky Schroeder, Enlightened Thinker (Unit 3)
     5. Humans with Wings (Unit 3)
     6. The Dinosaurs of Water House (Unit 3)
     7. A Model Scientist (Unit 3)
     8. Special Effects in Film (Unit 3)
     9. Sweet Music in Harlem (Unit 6)
6. **Concept Block One Content Summary**

**5Sa.1:** Identify questions suitable for generating a hypothesis.

* The scientific method is the basis of all scientific inquiry. It is important for anyone endeavoring to test a hypothesis to have a grasp of this concept.The Scientific Method is not complicated or difficult. In its most basic form, it’s the same thing you do when you successfully solve a problem. The basic steps of the process are as follows:
* Observation- it starts with seeing a problem

1. Define the Problem
2. Gather data/information

* Hypothesis- Make an informed guess about what’s going on
* Experimentation- test your guess
* Conclusion: look at your results and decide if your experiment supported your hypothesis. If it did, then you have a theory. If not, you have to go back to the beginning and see if you missed something.
* With children you can connect this concept to the way they solve problems every day. For example:

1. Observation: My Shoes are Missing
   1. Problem: Where did I leave my shoes?
   2. Data (background information): I wore them yesterday, yesterday was rainy
2. Hypothesis: Maybe I took my shoes off outside because they were muddy
3. Experiment: I will open the door and look outside
4. Conclusion: If was correct and my shoes are on the front porch, I’m good to go. If not, I have to start over until I find my shoes.

* A hypothesis is a possible explanation for an observation or scientific question. A properly stated hypothesis forms the basis of all scientific investigation. A hypothesis should be based on prior observation and data collection. This is what separates the hypothesis from a simple guess. It is an informed or educated guess. Students must be careful to choose a hypothesis that can be easily supported by investigation or experimentation, in other words, it must be testable. Hypotheses are generally written as if/then statements. A typical hypothesis might look like this:

“If\_\_\_\_\_\_\_\_\_(I do this), then\_\_\_\_\_\_\_\_\_(this)\_\_\_\_\_\_\_\_will happen.

**5Sa.2:** Identify independent (manipulated), dependent (responding), and controlled variables

in an experiment.

**5Sa.3:** Plan and conduct controlled scientific investigations, manipulating one variable at a time.

* All scientific experiments must be carefully designed and executed in order to ensure the validity of conclusions (you have to make sure your results are accurate).
* Many factors can affect the results of an experiment. Those factors are called variables
* **Variables-** are factors that can cause changes to occur. For example, how I dress depends on many ‘factors”. How I dress varies from day to day. If it is cold I’ll wear a coat. If it is hot I’ll wear shorts. If it is rainy I will need an umbrella. All of these factors are variables.
* For an experiment to be valid you can only test ONE VARIABLE at a time. Therefore you have to control all of the other possible influencing factors (see below).
* **Controlled Experiments**- are experiments in which all variables but one has been “controlled” so that they cannot influence results.
* Example: I invent a fertilizer for plants. I test the fertilizer by adding it to a houseplant. After two weeks my plant has doubled in size, so I conclude that my fertilizer works. But, what else might have caused the growth?
* Temperature
* Amount of sunlight
* Amount of water
* Normal plant growth

There are too many possible causes, so I cannot accurately conclude that my fertilizer works. It may not have. There were too many variables involved! I can fix my problem by making sure that any growth that occurs is due to my fertilizer. I can control my experiment by testing a group of plants (10 or 20 for example). I can divide them into groups, and label half of them “test group” and half of them “control group”. To control my experiment I will:

* Keep all plants at the same temperature
* Keep all plants under the same light
* Give all plants the same amount of water
* Make sure all of my plants are of the same type
* Add fertilizer ONLY to the plants in my test group

Now, if the plants in my test group grow considerably larger than those in my control group, I can conclude that my fertilizer probably works.

We can take this concept further and demonstrate that there are actually two kinds of variables, dependent and independent.

The **Independent Variable** is what you are testing (what you change). It is the part of the experiment that you are manipulating. In this case it is the fertilizer. You can think of an independent variable like it’s an independent person. It is stubborn and won’t change. So, how will I know if my independent variable works? It *depends*!

The **dependent variable** changes as a result of the independent variable (what changes). Will the plants in my test group grow larger than the control plants? It *depends* on whether or not my fertilizer works. The plant growth rate is my dependent variable.

**5Sa.4:** Use appropriate tools and instruments (including a timing device and a 10x magnifier)

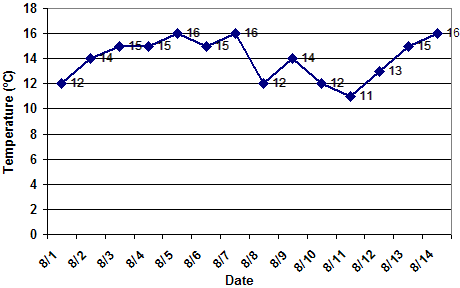
safely and accurately when conducting a controlled scientific investigation.

**5Sa.5:** Construct a line graph from recorded data with correct placement of independent

(manipulated) and dependent (responding) variables.

* Graphs can be useful for organizing and displaying quantitative data (see 4Sa1). Line and bar graphs are typically used to display scientific measurements and observations. Though students will be familiar with graphing in math, they may need a bit of assistance in transferring that knowledge to science and data collection. Essential to this is an understanding of variables in relation to graphing.
* In an experiment, independent variables are what or who you are testing, they represent the constant factor. For example, say I want to graph changes in average temperature over a set number of days. The temperature will vary, the days will not, so the days are my independent variable. Independent variables should always be charted on the horizontal (X) axis.
* In the above example, the temperature (dependent variable) changes over time (independent variable). Dependent variables should be charted on the vertical (Y) axis. So the resulting graph would look like this:

Temperature Changes Over Time



source: CIESE

**5Sa.6:** Evaluate results of an investigation to formulate a valid conclusion based on evidence

and communicate the findings of the evaluation in oral or written form.

* Once students have developed and tested a hypothesis, they must review their results to determine whether or not their hypothesis was supported.
* In order to assure validity, students must review their data objectively. It is important for them to understand that their results may or may not support their hypothesis.
* Once the results have been reviewed, a conclusion must be drawn. The conclusion should state whether or not the hypothesis was supported, and may include supporting data.

**5Sa.7:** Use a simple technological design process to develop a solution or a product,

communicating the design by using descriptions, models, and drawings.

**5Sa.8:** Use appropriate safety procedures when conducting investigations.

1. **Suggested Resources:**

The following sites provide activities and ideas in support of the above standards. Some can be used as is; others may need to be leveled for use in the fifth Grade classroom. All of them can be used as references to provide ideas for assisting your instruction.

**5Sa.1:** Identify questions suitable for generating a hypothesis.

<http://www.howany.com/how-to-create-a-hypothesis/>

<http://www.sciencekidsathome.com/science_fair/experiment_design.html>

<http://www.super-science-fair-projects.com/science-experiments-for-kids.html>

**5Sa.2:** Identify independent (manipulated), dependent (responding), and controlled variables in

an experiment.

<http://www.cool-science-projects.com/independent-and-dependent-variables.html>

<http://www.sciencebuddies.org/science-fair-projects/project_variables.shtml>

h<ttp://chemistry.about.com/od/sciencefairprojects/a/What-Is-A-Variable-In-S>cience.htm

**5Sa.3:** Plan and conduct controlled scientific investigations, manipulating one variable at a time.

<http://www.dummies.com/how-to/content/designing-experiments-using-the-scientific-method.html>

<http://explorable.com/conduct-science-experiments>

<http://www.livescience.com/topics/experiments-for-kids/>

**5Sa.4:** Use appropriate tools and instruments (including a timing device and a 10x magnifier)

safely and accurately when conducting a controlled scientific investigation.

<http://blog.onlineclock.net/clocks-and-timers-in-science/>

<http://www.microscope-microscope.org/>

**5Sa.5:** Construct a line graph from recorded data with correct placement of independent

(manipulated) and dependent (responding) variables.

<http://staff.tuhsd.k12.az.us/gfoster/standard/bgraph2.htm>

<http://iteachbio.com/skills/skills.htm>

<http://iqa.evergreenps.org/science/resources/graphing/graphing.htm>

**5Sa.6:** Evaluate results of an investigation to formulate a valid conclusion based on evidence

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<http://ecommerce.nsta.org/enewsletter/2003-06/member_elementary.htm>

<http://www.nsta.org/elementaryschool/>