

# Teaching Science Effectively in the Elementary Grades

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# Being A Successful Science Teacher

**Effective planning, organization, preparation and management will enable success in science instruction.**

- Know your science core
- Plan out your year
- Organize your materials
- Having great science lesson plans
- Know how to set up experiments
- Managing students during experiments
- Having good science books to read

# Kindergarten Science Core

1. Earth and Space Science
  1. Non-living things
  2. Changes in night and day
  3. Changes in the weather over time
2. Physical Science
  1. How non-living things move
  2. Describe parts of non-living things
3. Life Science
  1. Investigate living things
  2. Describe the parts of living things

# First Grade Science Core

1. Earth and Space Science
  1. Investigate rock, soil, and water
  2. Changes of the sun and moon during daylight
  3. Compare seasonal weather changes
2. Physical Science
  1. Changes in movement of non-living things
  2. Analyze objects and their properties
3. Life Science
  1. Similarities between offspring and parents
  2. Living things depend on their environment

# Second Grade Science Core

1. Earth and Space Science
  1. Rocks
  2. Objects and patterns in the sky
  3. Seasonal weather patterns
2. Physical Science
  1. Falling objects
  2. Materials responding to change
3. Life Science
  1. Survival in the environment
  2. Basic needs of living things

# Third Grade Science Core

1. Moon and Earth
2. Living and Non-living in the Environment
3. Forces and Motion
4. Force of Gravity
5. Heat and Light for Living Things

# Fourth Grade Science Core

1. The Water Cycle
2. Elements of Weather
3. Properties of Rocks, Breaking Down of Rocks/Erosion, and Components of Soil
4. How Fossils Form
5. Utah Environments

# Fifth Grade Science Core

1. Chemical and Physical Changes
2. Constant Reshaping of Earth's Surface
3. Magnetism and Magnetic Fields
4. Static and Current Electricity
5. Inherited Traits



# Six Grade Science Core

## 1. Structure and Motion Within the Solar System

Moon patterns and eclipses, seasons, gravity, and inertia, scale, and properties of objects within the solar system.

## 2. Energy Affects Matter

Molecules, atoms, and combinations; heat and energy on matter, density, particle movement in matter, and heat transfer.

# Sixth Grade Science Core

3. Earth's Weather Patterns and Climate  
Cycling of Water, cause of changes in weather, air mass flow, unequal heating, greenhouse effect, and Earth's energy balance
4. Stability and Change in Ecosystems  
Resources availability, interactions among organisms, producers, consumers, and decomposers, changes in ecosystems affect population, and preserving ecosystems.

# Where Can Lesson Plans Be Found?

- Grade science lesson plans are organized by standard and objective:
  - <http://elemscience.jordandistrict.org/lessons/>
- For random lesson plans alphabetically for your grade of your science core:
  - <http://www.uen.org/k12educator/corelessonplans.shtml>
- For specific lesson plans for your grade in each individual standard and objective of your science core:
  - <http://www.uen.org/core/>

# K-2 Grades: Teach with Intended Learning Outcomes in Mind

## ► Objective 1

### ➤ Generating Evidence:

- Using the processes of scientific investigation
  - (i.e. framing questions, designing investigations, conducting investigations, collecting data, drawing conclusions)

# K-2 Grades: Teach with Intended Learning Outcomes in Mind

## ► Objective 2

### ➤ Communicating Science:

- Communicating effectively using science language and reasoning

# K-2 Grades: Teach with Intended Learning Outcomes in Mind

## ▶ Objective 3

### ➤ Knowing in Science:

- Understanding the nature of science

# 3-5 Grades: Teach with Intended Learning Outcomes in Mind

- ▶ **Intended Learning Outcomes for 3-5 Grade Science**
  - ▶ The Intended Learning Outcomes (ILOs) describe the skills and attitudes students should learn as a result of science instruction. They are an essential part of the Science Core Curriculum and provide teachers with a standard for evaluation of student learning in science. Instruction should include significant science experiences that lead to student understanding using the ILOs.
- ▶ **The main intent of science instruction in Utah is that students will value and use science as a process of obtaining knowledge based upon observable evidence.**

# 3-5 Grades: Teach with Intended Learning Outcomes in Mind

## 1. Use Science Process and Thinking Skills

- ▶ Observe simple objects, patterns, and events and report their observations.
- ▶ Sort and sequence data according to criteria given.
- ▶ Given the appropriate instrument, measure length, temperature, volume, and mass in metric units as specified.
- ▶ Compare things, processes, and events.
- ▶ Use classification systems.
- ▶ Plan and conduct simple experiments.
- ▶ Formulate simple research questions.
- ▶ Predict results of investigations based on prior data.
- ▶ Use data to construct a reasonable conclusion.



# 3-5 Grades Teach with Intended Learning Outcomes in Mind

## 2. Manifest Scientific Attitudes and Interests

- ▶ Demonstrate a sense of curiosity about nature.
- ▶ Voluntarily read and look at books and other materials about science.
- ▶ Pose science questions about objects, events, and processes.
- ▶ Maintain an open and questioning mind toward new ideas and alternative points of view.
- ▶ Seek and weigh evidence before drawing conclusions.
- ▶ Accept and use scientific evidence to help resolve ecological problems.

# 3-5 Grades: Teach with Intended Learning Outcomes in Mind

## 3. Understand Science Concepts and Principles

- ▶ Know and explain science information specified for the grade level.
- ▶ Distinguish between examples and non-examples of concepts that have been taught.
- ▶ Solve problems appropriate to grade level by applying science principles and procedures.

# 3-5 Grades Teach with Intended Learning Outcomes in Mind

## 4. Communicate Effectively Using Science Language and Reasoning

- ▶ Record data accurately when given the appropriate form (e.g., table, graph, chart).
- ▶ Describe or explain observations carefully and report with pictures, sentences, and models.
- ▶ Use scientific language in oral and written communication.
- ▶ Use reference sources to obtain information and cite the source.
- ▶ Use mathematical reasoning to communicate information.

# 5<sup>th</sup> Grade: Teach with Intended Learning Outcomes in Mind

## 5. Demonstrate Awareness of Social and Historical Aspects of Science

- ▶ Cite examples of how science affects life.
- ▶ Understand the cumulative nature of science knowledge.

# 5<sup>th</sup> Grade: Teach with Intended Learning Outcomes in Mind

## 6. Understand the Nature of Science

- ▶ Science is a way of knowing that is used by many people not just scientists.
- ▶ Understand that science investigations use a variety of methods and do not always use the same set of procedures; understand that there is not just one "scientific method."
- ▶ Science findings are based upon evidence.

# 6th Grade: Teach with Three Dimensional Science In Mind

- ▶ **TEACHING THE NEW 6TH GRADE SCIENCE SEED CORE USING THREE DIMENSIONS OF SCIENCE**
  - Scientific and Engineering Practices (SEP)
  - Crosscutting Concepts (CCC)
  - Disciplinary Core Ideas (DCI) Science

**Teaching should engage students in performances of science at the intersection of these three dimensions.**

# 6th Grade: Teach with Three Dimensional Science In Mind

## Scientific and Engineering Practices

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

# 6th Grade: Teach with Three Dimensional Science In Mind

## Crosscutting Concepts

1. Patterns
2. Cause and Effect
3. Scale, proportion, and quantity
4. Systems and system models
5. Matter and energy
6. Structure and Function
7. Stability and change



# 6th Grade: Teach with Three Dimensional Science In Mind

## **Disciplinary Core Ideas**

1. Earth and Space Science
2. Life Science
3. Physical Science
4. Engineering

# TEACHING The SCIENCE CORE USING THE CURIOSITY OF PHENOMENA

- ▶ Humans are born with innate curiosity.
- ▶ They explore their environment and seek to know more without any help from anyone.
- ▶ Curiosity is an emotion that fuels science learning.
- ▶ Curiosity is related to inquisitive thinking, exploration, investigation, and learning.
- ▶ Curiosity is one of the significant human motivations for scientific investigations as well as for inquiries to discover knowledge.
- ▶ Since the early times humans have sought explanations for natural phenomena.
- ▶ Fortunately, our world (and universe) is full of intriguing things to wonder about.

# Three Dimensions of Science

- Science education includes three dimensions of science understanding:
  - science and engineering practices
  - crosscutting concepts
  - disciplinary core ideas.
- Every standard includes each of the three dimensions
  - **Science and Engineering Practices are bolded.**
  - Crosscutting Concepts are underlined.
  - Disciplinary Core Ideas are in normal font.
  - *Standards with specific engineering expectations are italicized.*

# Three Dimensions of Science--Example

## Standard 6.2.4

**Design an object, tool, or process** that minimizes or maximizes heat energy transfer. *Identify criteria and constraints, develop a prototype for iterative testing, analyze data from testing, and propose modifications for optimizing the **design solution**.* Emphasize demonstrating how the structure of differing materials allows them to function as either conductors or insulators.

## TEACHING The SCIENCE CORE USING THE CURIOSITY OF PHENOMENA

- ▶ Curiosity is the aspect of learning which is going to lead to student investigation and wonder.
- ▶ Students will learn best by investigating phenomena to make sense of their world.
- ▶ When student learn science in this fashion, it will last a lifetime because they own what they have discovered themselves.
- ▶ There is much joy from investigating science phenomena.

# TEACHING The SCIENCE CORE USING THE CURIOSITY OF PHENOMENA

- ▶ 1. Curiosity of a Phenomenon
  - Observe
  - Ask Questions
  - Wonder
- ▶ 2. Interest
  - Seek information and data
- ▶ 3. Reasoning
  - Use reasoning to construct explanations based on evidence

# How Do I Make an Activity Happen For Science Investigation?

- Start out with a phenomenon.
- Using crosscutting concepts (Intended Learning Outcomes) and science and engineering practices (Scientific Discovery), students will design an experiment.
- Materials, Plan, Variables, Written Data
- Make a model with an explanation of what happened.
- Share what was found out using the evidence found in the experiment.

# Managing Groups During Lab Work

- ▶ Practice group work before doing science
- ▶ Keep groups small (2-4) is best
- ▶ Assign each group member a job
- ▶ One member should be the leader
- ▶ Give specific and detailed instructions
- ▶ Model as much as possible
- ▶ Forecast and plan for “glitches”
- ▶ Use graphic organizers
- ▶ Always have enough time for clean-up
- ▶ Always stress safety



# Rules During Lab Work

- ▶ Follow the directions
- ▶ Don't work ahead
- ▶ Everyone stays on task
- ▶ No talking within the group about other things
- ▶ No group member bothers a member of another group
- ▶ No goofing around
- ▶ Work on a timely basis--keep things going
- ▶ Students assigned to a certain task are the ones who do that task
- ▶ Keep it safe all the time--no exceptions

# Journaling Ideas

**Have students use a journal as much as possible when doing experiments.**

- Use of journal during an experiment:
  - ▶ Writing down measurable data
  - ▶ Explaining what they saw happen
  - ▶ Making a graph
  - ▶ Explaining their thoughts on why it happened
  - ▶ Writing a conclusion

## 3-6 Grades Science Literacy OER Books (Open Education Resource Books)

- ▶ There are science textbooks that Utah State Office of Education have written called Open Education Resource Books (OER). These books are written specifically for the respective grade levels.
- ▶ These OER books are tweaked each year to make them better. They only cost around \$3.00 each. Click on this link to review these books.

<https://utah-science.myshopify.com/>

Ask your colleagues or principal about purchasing them for they will really enhance your science class instruction and help raise your science scores.

# A Phenomenon Experiment: Making a Cloud

▶ Clouds are a phenomenon. Not very many people really know what causes clouds to form.

▶ Questions:

▶ Why are the skies sometimes completely clear?

▶ Why does the sky fill up with clouds?

▶ Why are the skies sometimes partly cloudy?

▶ Why do clouds come and go?

▶ Lesson Plan:

<http://elemscience.jordandistrict.org/files/6.3.2.1a-Making-a-Cloud-in-a-Bottle.pdf>