



Hands-on Science

Learning the scientific method (and higher order thinking) by doing

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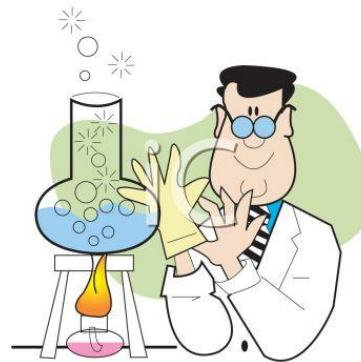
Goals for this session

- ▶ Plan to integrate scientific inquiry and other student-centered activities into lessons when you have limited time and instructional resources
- ▶ Participate in/try out activities that you can use with your students
 - ▶ Vocabulary acquisition
 - ▶ Investigation design
 - ▶ Working with data
 - ▶ Close reading
 - ▶ Experiments



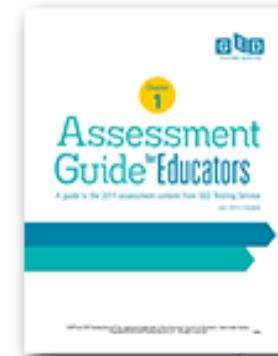
It's not a waste of time to do activities in Science!

- ▶ The more you DO, the more you LEARN
- ▶ Engagement + Purpose= Learning
- ▶ Pyramid of Integration
 - ▶ Audio (listen, lecture) 5%
 - ▶ Visual (see, powerpoint, videos) 10%
 - ▶ Info gathering (research) 20%
 - ▶ Communication (speaking & listening) 40%
 - ▶ Practice & Production (making, doing) 70%
 - ▶ Processing, Creating, Applying 90%



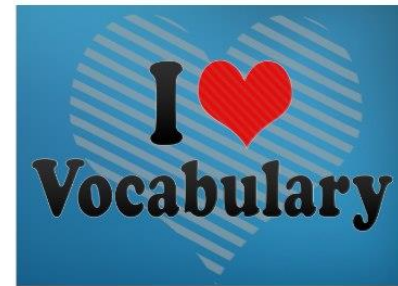
Translating the Assessment Guide into instruction

- ▶ Students will need to have experiences in the practices-not just read about them in a text!
- ▶ Must know
 - ▶ Key vocabulary (comprehending presentations, information, theories)
 - ▶ The steps in scientific method (investigation design)
 - ▶ Some practice working with data from tables, graphs and charts
 - ▶ Close reading skills
 - ▶ Experiments



Ideas for vocabulary acquisition

- ▶ Students will need to be able to recognize or decode scientific vocabulary!
- ▶ Focus on context and conceptual understanding
 - ▶ Try to avoid giving out word lists that teach vocabulary in isolation
- ▶ Visuals
- ▶ Multi-sensory strategies
- ▶ Word parts
- ▶ Interlanguage

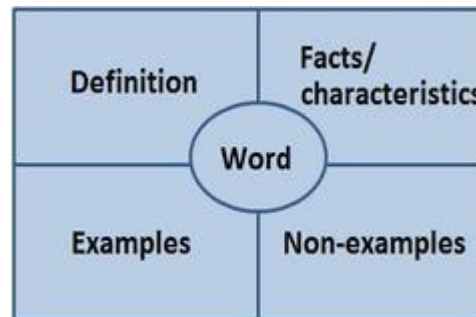


S. Carter, <http://www.learnnc.org/lp/pages/7079>

Science Penguin <http://thesciencepenguin.com/2013/12/science-solutions-vocabulary.html>

Visuals

- ▶ Have students use a visual thesaurus
 - ▶ <https://www.visualthesaurus.com/> : pronounces word, lists definitions, creates a map of related terms (limited free trials from ThinkMap)
 - ▶ Visuwords <http://visuwords.com/> visual thesaurus and interactive features
- ▶ Graphic organizers
- ▶ Frayer Model or Marzano Squares
 - ▶ Word, picture/non-linguistic representation, student example, definition, synonym or antonym if applicable

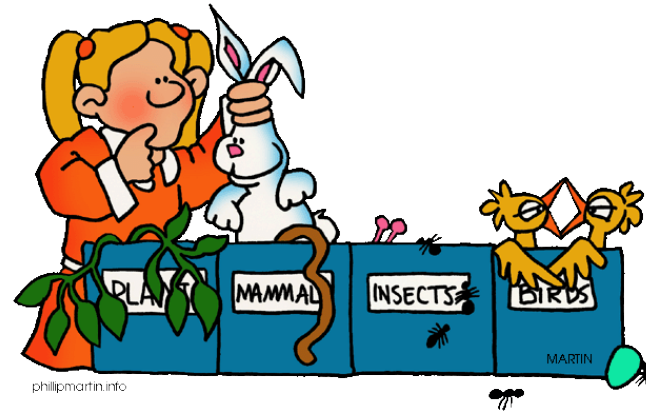


Try This!

- ▶ Select one of these scientific terms and complete a Frayer model
 - ▶ Cytoplasm
 - ▶ Mitosis
 - ▶ Magma

Multi-sensory

- ▶ Audiotaped instructions alongside written directions
- ▶ Pictures with words in stages of lab procedures that students can sequence
- ▶ Text cards
 - ▶ True/false cards
 - ▶ Agree/disagree cards
 - ▶ Matching pairs
 - ▶ Sequencing cards
 - ▶ Classifying/sorting



Word parts

- ▶ Some video resources to help:
- ▶ Divide and conquer more complex compound words
 - ▶ Prefixes, Suffixes, Root/base words
- ▶ Examples
 - ▶ **photosynthesis** – photo (light), synth (make), isis (process)
 - ▶ **metamorphosis** – meta (large), morph (change), osis (process)
- ▶ How to Understand Science Words-Science Nut
<https://www.youtube.com/watch?v=xHx2tsBkTYw> (4 min)
- ▶ Breaking Down the Language of Science
<https://www.youtube.com/watch?v=d7fEpAKsdw8&t=3s> (2 min)

Try some: use the scientific root words, prefixes and suffixes list to build words!

Try this!

- ▶ Break these words into their component parts to decode their meaning:
 - ▶ Exothermic
 - ▶ Homosapien
 - ▶ Paleontology

Interlanguage

- ▶ Translating everyday speech into the language of science
- ▶ Example
 - ▶ Student: “We put this smooth powder in the bag along with the crunchy powder and the bag blew up and got hot.”
 - ▶ Teacher: “We mixed baking soda and calcium chloride with water resulting in a gas, and heat was released.”
 - ▶ Scientist: “The combination of baking soda and calcium chloride is an exothermic reaction with the products of sodium chloride, calcium carbonate, and carbon dioxide.”

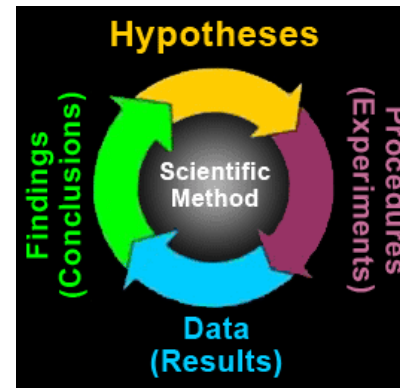
Try this!

- ▶ Translate this phrase into a more precise scientific statement:

The human body gets its shape from a bunch of bones including a head bone, back bones, hip bone and leg bones.

Teaching the Scientific Method

- ▶ Students will be asked to examine and critique experimental design!
- ▶ Quick overview of the scientific method from Teacher's Pet:
<https://www.youtube.com/watch?v=SMGRe824kak>
- ▶ Direct instruction on the steps
- ▶
 1. Ask a question.
 2. Make a hypothesis.
 3. Test the hypothesis with an experiment.
 4. Analyze the results of the experiment.
 5. Draw a conclusion.
 6. Communicate results.
- ▶ Have students sequence the steps using sentence strips
- ▶ Develop everyday examples to familiarize students with the process



Try this!

- ▶ Use the sentence strips in the resource packet to put the steps of the scientific process into the proper order.

Two simple?

- ▶ The scientific method has been under some scrutiny in the scientific community as an over-simplified version of the science process.
- ▶ The process of science is
 - ▶ Iterative
 - ▶ Not predetermined
 - ▶ Has many routes or launching points
 - ▶ New technology, practical problem, curiosity, personal motivation, serendipity, surprising observation
- ▶ This new version encompasses the traditional model but adds a degree of complexity and sophistication that what really happens in science.

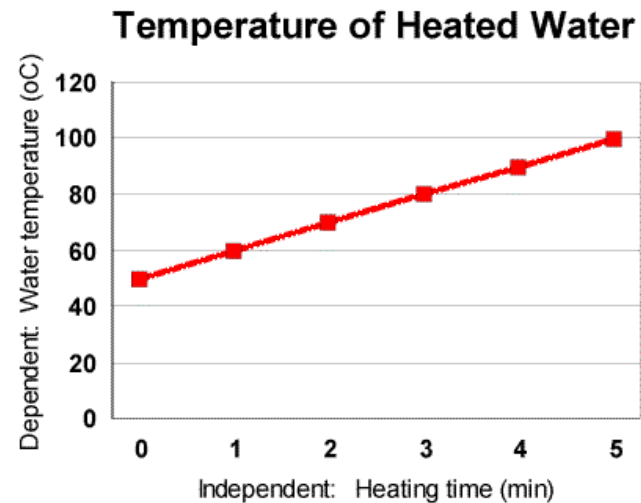
www.understandingscience.org

Tables, Graphs and Charts

- ▶ Students will be asked to respond to questions utilizing tables, graphs and charts!
- ▶ How to make a line graph
 - ▶ 1. Label the x axis (horizontal axis) with the independent variable.
 - ▶ 2. Label the y-axis (vertical axis) with the dependent variable.
 - ▶ 3. Determine the range of your data that must fit on each axis. The range will set the scale.
 - ▶ 4. Number each axis division (line). Each division should be equally spaced.
 - ▶ 5. Plot each data pair accurately as a point on the graph.
 - ▶ 6. Choose a title that describes the graph.

Try this out

- ▶ Examine the data from “Testing AA Batteries in a Flashlight”
- ▶ Use the checklist to create a chart to display the data on the table.
- ▶ Create three questions that can be asked and answered from the available data.



Close Reading in Science

- ▶ Students will need to read for comprehension and extract main ideas, key details and evidence from complex texts!
- ▶ Teacher work to prepare for using complex text that require close reading:
 - ▶ Select “compact, short, self-contained texts that can be read and reread deliberately and slowly” (Coleman & Pimentel, 2012, p.4).
 - ▶ Identify purpose for reading
 - ▶ Prepare text for presentation
 - ▶ Develop/share annotation scheme (key ideas, confusing, wondering, surprises)
 - ▶ Prep text dependent questions

Close reading process

- ▶ First reading: share purpose and process
- ▶ Chatting and charting: share responses and annotations with a partner
- ▶ Second reading: to research specific questions, comments from debriefing
- ▶ Chatting and charting: share back evidence from the text
- ▶ Independent work: respond to the text dependent questions

5 Steps for Close Reading

1. Read for a general first impression.
2. Re-read and mark up the text (tricky/interesting/action words).
3. Write predictions, opinions, and connections.
4. Ask questions (open-ended).
5. Decide big ideas/themes.

Then discuss your notes!

Types of text dependent questions in Science

- ▶ Comprehension questions: what does the text say?
- ▶ Text structure: how are parts arranged?
- ▶ Sequence: identify/analyze steps
- ▶ Clarification: ask for further explanation
- ▶ Inferential: reach conclusions from evidence in text not stated
- ▶ Organizing: sort the information by relevant criteria
- ▶ Academic vocabulary: determine word/concept meaning by context
- ▶ Purpose: what's the function or deeper meaning of the text



Try this out

ReadWorks.org

- ▶ Select one of the texts from ReadWorks.org (approximately Gr 8 reading level)
- ▶ Complete a first reading for general comprehension
 - ▶ What is the main idea?
 - ▶ What are the key words (academic vocabulary)?
 - ▶ Did anything surprise or confuse you in the reading?
- ▶ Discuss content with a partner
- ▶ Read again to respond to text dependent questions (require evidence from the text to answer)

Experiments

- ▶ Students will be able to retain knowledge and skills better if actually experiencing the content in multi-modalities
- ▶ Opportunity to design, conduct and critique investigations
- ▶ Can be done with limited time, resources, mess (sometimes!)

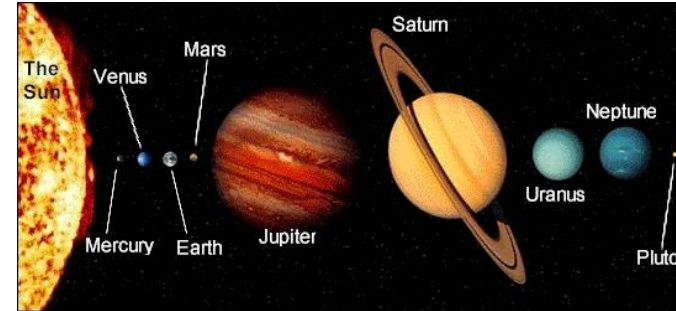


Physical Science



- ▶ Science Inquiry: Which Falls Fastest?
- ▶ GED Testing Service
- ▶ Theme: Effects of Air Resistance on different paper types
- ▶ Steps:
 - ▶ Make your plan (variables/constants, question, hypothesis)
 - ▶ Identify dependent/independent variables
 - ▶ Conduct experiment/collect data
 - ▶ Analyze and conclusion

Earth and Space Science



- ▶ Science Inquiry: Distances in the Solar System
- ▶ GED Testing Service
- ▶ Theme: Conceptualize distances in solar system by building a scale model
- ▶ Steps:
 - ▶ Assemble materials (distances table, roll of toilet paper, marker)
 - ▶ Construct the scale model based on the table
 - ▶ Reflect and process experience

Life Science



- ▶ Science Inquiry: Heart Rate
- ▶ GED Testing Service
- ▶ Theme: Impact of physical activity on heart rate
- ▶ Steps:
 - ▶ Take and record resting pulse
 - ▶ Walk, speed walk, jog, take pulse for minute following each and record the rate
 - ▶ Create a table or graph
 - ▶ Analyze and develop conclusions

What if you are not able to conduct live experiment?



- ▶ Myth Busters

- ▶ MythBusters viewing guide

- ▶ Archived episodes and episode guide: <http://www.discovery.com/tv-shows/mythbusters/>

- ▶ Skunk Bear/NPR

- ▶ Stone Soup: How to Make Lava (You Tube or https://www.youtube.com/watch?v=25tYMaB70AI&index=29&list=PLKqe_oheltif3ow0EE6b3Tkf2pWxwRqs9)

Reflection

- ▶ How is this type of science different from the traditional methodology of teaching and learning science content?
- ▶ In what ways is this approach more student-centered?
- ▶ GED Science requires some knowledge of content and vocabulary but contains much more emphasis on the scientific practices and reasoning skills



Questions and Feedback

- ▶ Please take a few minutes to provide feedback on this session:
<https://www.surveymonkey.com/r/ECAAdultEd1516>
- ▶ Sign up for other technology, GED Science, GED Social Studies and teacher evaluation workshops at www.edadvance.org/atdn
- ▶ For additional questions, contact
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