## SOME IMPORTANT SCIENCE TEACHING TECHNIQUES
--Students each choose one to present to the class—
(H. Weller, EDW 472/SMS 491, Spring 2008)

<table>
<thead>
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<th>TECHNIQUE NAME</th>
<th>DESCRIPTION</th>
<th>EXAMPLE</th>
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| (1) Advance Organizer | (Stage 1) Presentation by the teacher of a “scaffolding” that links new learning to prior learning—in written, oral, graphic, and/or pictorial form. (Stage 2) Logical presentation of the new learning. (Stage 3) Strengthening the students’ cognitive organization by periodically calling attention to the relation of the new learning to the advance organizer. | • Many uses of the Periodic table in chemistry  
• Comparison of a biological cell to a factory. | Ebenezer & Haggerty (1999), p. 222.  
| (2) Demonstration | A demonstration is, in effect, a performance by the teacher or other person. It is often an advance organizer for organizing information and activities that will follow, into a meaningful framework. It can stimulate student attention, interest, and discussion. It can also be used as a summary of previous learning. | • Demonstrate the use of a burette in chemistry.  
| (3) Imagery | Use of a picture or diagram to represent concepts and/or principles that are difficult to imagine. This provides students with cognitive aids that make abstract ideas more comprehensible. | A Visual Representation of:  
• Concentrations of ions in solution  
| --- | --- | --- | --- |
| (4) Analogistic Thinking | An analogy forms a relationship between what the learner is familiar with (the analogue) and what he or she is expected to learn, the unfamiliar (the target). The analogy helps the student make connections between what he or she knows and what the instructor wants him or her to know. | **Glynn’s teaching-with-analogies model** (in Chiapetta & Koballa Jr. (2006, p. 136).  
1. Introduce the target concept.  
2. Review the analogue concept.  
3. Identify the features of the target and analogue.  
4. Map the similarities.  
5. Indicate where the analogy breaks down.  
6. Draw conclusions.  
• “Electricity” (target) is like “water flowing through pipes” (familiar).  
| (5) Synetics – Making the Strange Familiar | This process increases the students’ understanding and memory of substantially new or difficult material. Students constantly alternate between defining the characteristics of the more familiar subject and comparing these to the characteristics of the unfamiliar topic. | Phase 1) Teacher provides information on the new topic.  
Phase 2) Teacher suggests a direct analogy and asks students to describe the analogy.  
Phase 3) Teacher has students “become” the direct analogy.  
Phase 4) Students identify and explain the points of similarity between the new material and the direct analogy.  
Phase 5) Students explain where the analogy does not fit.  
Phase 7) Students provide their own direct analogy And explore the similarities and differences.

- “An e-coli cell is like an automobile.”
- Protein synthesis is like a mass production line in a factory.”

| (6) Positive/ Negative Exemplars for Concept Introduction | Students figure out the Attributes of a category that Is already formed in another Person’s mind, by comparing And contrasting examples (exemplars) that contain the characteristics (attributes) of the concept with examples that do not contain those attributes. These are often presented in exemplar- nonexemplar pairs. The pairs are presented pair by pair. During the process, students write down their hypotheses as to the attributes. Students share their hypotheses. When they agree on the hypotheses that appears most likely, they generate a label for them. Then the teacher supplies the technical label. Students then search for more items of the class. | WHAT IS THIS LIVING THING? | Variation #1  
Teacher presents exemplar-nonexemplar pairs, pair by pair. Examples:  
- Hairy skin – scaly skin  
- Bear young alive – lay eggs  
- Nourish young with milk from glands – Allow  
- Young to fend for themselves  
Variation #2  
Teacher presents exemplars and nonexemplars one By one. Each is accompanied by “Yes” or “No.”  
Examples:  
- Hairy skin (Yes)  
- Scaly skin (No)  
- Bear young alive (Yes)  
- Lay eggs (No)  
- Nourish young with milk from glands (No)  
- Allow young to fend for themselves (No)  
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<th>Deductive Activities</th>
<th>IDENTIFYING ACIDS AND BASES</th>
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|   | A generalization, like a concept or principle, is first defined and discussed. Then the students have firsthand or concrete experiences to illustrate the generalization. | **Presentation of Generalization(s):** Students are presented with definitions and properties of acids and bases, based on Arrhenius theory, Bronsted-Lowry theory, and Lewis theory. The attributes of acids and bases are presented. The idea of pH, and various ways to measure pH, are presented. **Classification of solutions as acids and bases:** students are given several solutions, which they must classify as either acids or bases and find the pH. **Post laboratory discussion:** Students’ findings are discussed and their understandings are determined. | Collette & Chiappetta (1994). Pp. 97-98.  
|   | (7)                  | (8)                         | (9) | (10) |
|   | Concept Mapping      |                             |     |      |
|   | The teacher or students Graphically display (or “map”) concepts and relationships between concepts, using node and labeled lines. A concept map may be hierarchical, a cluster, or a chain. | • As a diagnostic pretest before starting a unit on volcanism, students each draw concept maps for the concept “volcano” and any related concepts they can recall. | Ebenezer & Haggerty (1999), pp. 200-211. |
|   | Constructing a Vee Diagram | Use of Vee Diagram to aid the investigation of the Focus question: “What is the relation between water, Pressure, and depth?” | Ebenezer & Haggerty (1999), pp. 212-221. |
|   | Mnemonic Devices to Aid Memory | The teacher helps the students learn various uses of mnemonics – assists to memorization – to remember new information. Research shows that usually the more elaborate the mnemonic method, the better the recall | Link-Word method: Take familiar material and think of a link with the unfamiliar items. [E.g., to remember “Ohm’s Law, V=IR” you might link Ohm with Home, because Ohm sounds like Home. Then you think “Ohm is at home with a virus (VIR).”] |
Key Word method:
Select one word to represent a longer thought or several subordinate thoughts. [E.g., if you wish to remember that Archimedes’ Principle involves buoyancy, you could remember that Archimedes’ mood was “buoyed up” by his discovery of the principle.]

Ridiculous Association method:
The strength of a memory association is enhanced if the image is vivid and ridiculous, impossible, or illogical. To make an association ridiculous, use the “rule of substitution,” the “out-of-proportion rule,” or the “rule of exaggeration.” [E.g., to remember that water pressure increases with greater depth, picture a dam that becomes extremely thick at greater depths.]

Substitute-Word system:
To make something intangible, tangible and meaningful, take the abstract word or phrase and think of something that it sounds like or reminds you of that you can picture in your mind. [E.g., to remember “Darwin,” visualize a “dark wind.” To remember “Alaska,” remember it sounds like “I’ll ask her.”]

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<th>(11) Concept Circles</th>
<th>The concept-circle diagramming strategy focuses on the use of self-constructed diagrams to aid the process of reflection on one’s knowledge and to restructure personal knowledge. These are more like Euler’s Circles than</th>
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<td>Typically one puts a limit of about five circles (based upon the unit capacity of 7 ± 2 for short-term memory).</td>
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<td>• Example: A Concept Circle diagram of “Components of the U.S. Space Program (the label for the large circle)” would have four small interior circles labeled “Shuttle Flights,” “Space Station,” “Probes,” and “orbiting Satellites.”</td>
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Venn diagrams. This process can be used to assess the students’ prior knowledge, or for peer evaluations.

| (12) Science Projects | Science activities that require many hours of student, teacher, and parent involvement. Students identify a problem, propose questions to be answered, design procedures for investigation, gather information, examine the results, form conclusions, and present their findings. | • Class Projects  
• Science Fair Projects |

**REFERENCES**


