

Strategies Toolbox

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Introduction

Included in this booklet you will find a number of teaching and learning strategies that are described so as to be used in a high school science classroom, more specifically for Physics and/or Computer Science. Each strategy can be used in a variety of ways and among a diverse group of learners. These strategies are intended to enhance both the learning and teaching experience that occurs in and out of the classroom so that both students and teachers benefit. Although applications of the strategies are described and examples of how they may be used are given they are in no way concrete. There is an infinite number of learning and teaching techniques, these are merely a sample of those that have been proven to be useful thus far and may continue to be useful to both teachers and learners in the future.

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Concept Cards

Definition:

Concept cards, also called flash cards, are index cards that have things written on both the back and the front. One side will usually have a concept, term, name, etc and the other side will have all the relevant information that the student should know about the concept, term, or name.

Benefits:

Concept cards are an incredibly useful study tool for students. They are easy to organize in whatever way best suits the student and they are easy to carry around. A benefit they have over reading notes is that you need to flip the card over to see the information you need to remember while reading notes you only need to let your eyes slip to the next line.

Application:

Concept cards are more of a tool for students than for teachers but we can use them as well. While a teacher is getting used to the students in his or her classroom they can use cards with the students' names on them to keep information about each student. For instance if a teacher notices that one student responds very well to demonstrations or visual aids they can put that on the card.

Examples:

Newton's Laws

[front of card]

1st – Objects in motion stay in motion unless acted on by an outside force
2nd – $F = ma$
3rd – For every action there is an equal but opposite reaction

[back of card]

Johnny Doe

[front of card]

-Plays on the baseball team
-Struggles with algebra
-Works very well in groups

[back of card]

Concept Maps

Definition:

A concept map is a helpful, visual tool used to diagram the relationships between various concepts. Concepts are usually connected with arrows to emphasize the nature of the relationships or hierarchy. These relationships can be further articulated with linking phrases (i.e. “necessary for,” “results in,” “contributes to.”)

Benefits:

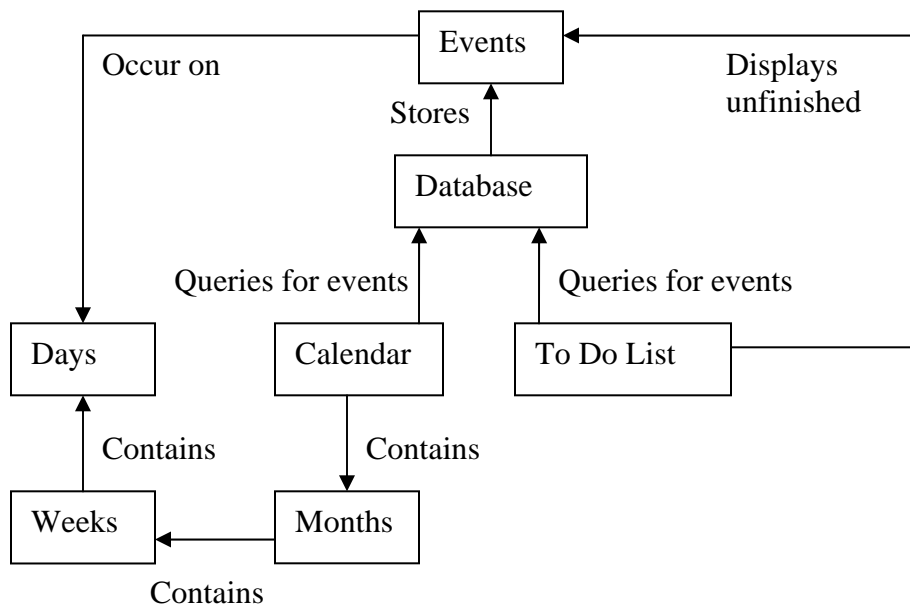
Concept maps are a great visual aid to help students see the relationships things have with each other that may not be apparent from reading or listening to a teacher. They can help organize thoughts, notes, work, and ideas. Concept maps are a tool that can be used throughout one’s lifetime so it is very beneficial for students to begin using them at an early age.

Application:

Since physics doesn’t really deal with many systems that have many interconnected parts there are not many practical applications of the concept map, graphical organizers would usually be more useful. For computer science however concept maps are extremely useful for diagramming programs. Just about every program that would be written in a high school computer science course could be and should be diagrammed using a concept map.

Examples:

This is an example of a concept map for a computer program that makes a calendar and a to-do list to organize events.



Split-Page Note Taking Format

Definition:

The idea of split-page note taking format is to draw a vertical line down each page of your notebook. On one side of the line normal notes are taken as they normally would be but on the other side of the line students write useful information that helps them to understand their notes better. This information could be a number of different things:

- Clarify remarks and summaries of the notes
- Comments indicating important points
- Explanation of how a problem was done step by step
- Questions about things that are unclear as reminders to ask the teacher or do more to clarify
- Rewording of notes the teacher gave that may not be clear

Benefits:

Split-page note taking really allows the student to personalize their notes and make their notebooks more efficient. The amount of space on every page of the notebook that is saved for special notes will most likely be more beneficial than the original notes or make previously useless notes valuable. Students have a very difficult time taking good notes but practicing this technique eventually helps them to take better notes.

Application:

Students should be encouraged to use this technique while taking notes for class and should be required to use it while doing any problems. Science and math problems are usually hard to follow but by having a certain amount of space reserved for the explanation of each step of a problem they become readable. Also doing this helps the student to understand why they do each step and helps them to really learn the thought process of completing a problem rather than merely using the trial and error method of applying formulas until the answer appears.

Examples:

<p>What is an isolated system?</p> <p>**Important Formulas**</p> <p>Put numbers in formulas Get two equations and two unknowns then solve for x and y. *not all E transferred</p>	<p>Momentum and energy both must be conserved in any isolated system</p> <p>$P = mv$ $KE = \frac{1}{2} mv^2$ $PE = mgh$</p> <p style="text-align: center;"> $P = 1 \cdot 10 = 10$ $P = 1 \cdot x + 10 \cdot y = 10$ $KE = \frac{1}{2} 1 \cdot 10^2 = 50$ $KE = \frac{1}{2} 1 \cdot x^2 + \frac{1}{2} 10 \cdot y^2 = 50$ $y = 0.18 \text{ m/s}$ $x = 8.2 \text{ m/s}$ </p>
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Book Talk

Definition:

A book talk is a short formal or informal conversation that reflects on a book's opinions, main ideas, and relationship to the content learned in class. The discussion can be lead by the students or the teacher and can be structured multiple different ways. The book should be a trade book and not a text book and the discussion should be more about opinions, concepts, and ideas then about facts.

Benefits:

Book talks are a great way to foster discussion among students, who often learn best when they hear things explained by their peers. Teachers can have as much or as little involvement as they feel they should during a book talk. They are a form of prewriting and help students organize the thoughts they have after reading a book. They can be a useful tool for assessment.

Application:

There is not much literature that is used in science classrooms today but very often there are articles in magazines, newspapers, or science forums on the internet that pertain to the content covered in high school science classrooms. Just because it is called a book talk does not mean that this same practice can't be applied to these articles as well.

Examples:

After talking about gravitational forces in class the students would be assigned to read an article on black holes. We would then have a discussion about forces in the universe and talk about what black holes are and the mysteries about them. I believe that students would find this interesting and we could have a very fun discussion that would be relative to the content of the course yet diverge from that of the day to day routine. As the teacher I would stay out of the discussion but inject questions that would stimulate more conversation and debate.

- If black holes have such a strong gravitational force will the entire universe eventually be sucked into one giant black hole?
- What happens to the light that shines on a black hole?
- Will black holes continue to grow or do they reach a point where something else happens? If so, what happens?
- Could black holes be portals through space time?
- How are black holes created?
- Can they be destroyed?

Learning Logs

Definition:

The learning log is a pedagogical strategy which allows a student to use writing as an aid in the process of constructing meaning from what he or she has read, observed, or listened to in class. The teacher usually provides a prompt like “List three things from last night’s reading that we should discuss in class” or “Explain how you can use what we just talked about in your day to day life” to which the students respond by writing in their learning log.

Benefits:

Learning logs help students to record the things they learn during a course so that they can look back at it later. Lots of students have trouble taking good notes, using learning logs lets the teacher tell them when to take notes and what to write about to make sure they are recorded things that are important. Learning logs can be used by the teacher as a form of informal assessment to see if students really understand the material being taught.

Application:

The learning log would be something that is used throughout a course and during the majority of lessons, there wouldn’t be any specific lessons that would really benefit or suffer by the use or omission of learning logs.

Examples:

Possible prompts for learning logs:

- List at least 10 ways that energy is transferred in your day to day life.
- Explain why a pendulum swings back and forth.
- Why do balloons shrink overnight?
- Explain what happens if you drop two bouncy balls stacked on top of each other. Why does this happen?
- What are the limits to the efficiency of an engine?
- What is the difference between making a series circuit and a parallel circuit? Give a few examples of when each would be appropriate.
- Give 3 examples of conservation of momentum and energy that you see every day.
- Why does ice float? What would happen if it didn’t?

Prewriting

Definition:

Prewriting is the first step of the writing process where thoughts and ideas are generated, explored, clarified, and organized. There are multiple strategies for doing this:

- Brainstorming – Jot down on paper all terms that come to mind when thinking about the topic.
- Free Writing – Write non stop about a topic for several minutes, even if nothing specifically useful comes to mind. When you are done go back and highlight or underline important or useful information.
- Clustering – Write the main subject in the center of a page and circle it. Any new idea that has to do with the main subject write somewhere around it and connect it to the main subject with a line. Continue this process with all the new ideas.
- Looping – Have a free writing session and when done go back and circle interesting ideas and then free write about those ideas. Continue this process until enough useful information is written down.
- Journalist Questions – Explore a topic by answering the questions: Who? What? When? Where? Why? How?

Benefits:

Prewriting helps one to gather thoughts and build a framework for something one would have to write. Prewriting is much easier than actual writing and makes the process of actually writing much easier and less stressful.

Application:

For any major writing assignment part of the student's grade could come from a prewriting assignment as well. This will take some of the weight off the writing assignment itself and ensure that students are using good writing techniques.

Examples:

Brainstorming for Energy:

Joules, work, force x distance, heat, light, temperature, potential, kinetic, spring, pendulum, atomic, nuclear,

Free Writing for Simple Harmonic Motion:

Things moving back and forth without stopping. They always go to the same place. A mass on a spring or a pendulum exhibit SHM. Simple harmonic motion is everywhere. A man rocking back and forth in a chair. Back and forth, to and fro. Gravity makes a pendulum and mass on a spring work. Gravity is a constant force. Always a restoring force in simple harmonic motion. No damping, no driving.

Previewing

Definition:

Previewing is when students are presented with a rough outline of the information that will be explained in detail at a later time. This information can be presented many different ways just as the details can later be explained many different ways. To preview a topic a teacher may brush over a few key points, ask the students to skim through a chapter of the text book, go over some terminology, or provide an outline that students have to fill in. To preview a textbook, students would be expected to look at introductory paragraphs, summaries, topic markers or boldfaced headings, visual aids, and questions or problems provided by the author. Good textbooks have a strong framework for the material that will help students grasp how concepts will be related by previewing before they even understand the concepts.

Benefits:

Previewing gives students a chance to prepare for the knowledge they are supposed to obtain. When students start reading a textbook and don't know what to expect they are rarely prepared for the flood of words they are presented with. Previewing helps them to expect certain things, which makes it easier to remember when you come upon them.

Application:

Don't expect any classroom of students to complete every reading assignment you give them. To assume a high school student will read a thirty page chapter from a science text book is naïve. To ask them to do so might not be beneficial at all, especially if they don't do it. Those that do may be so lost that all the material would have to be covered again in class anyway. A more practical solution would be to ask the students to preview the material in a chapter which takes less time and is much easier for them to do. Then when the material is covered in class the students will have an idea of what to expect and some knowledge of the relationships among the concepts which will make teaching easier for the teacher and learning easier for the students.

Examples:

Before teaching the unit on Newton's laws, have the students preview the material by going through the text book and writing down all the key words and all the formulas that are given. Whether the students realize it or not they will remember some of the formulas and will have an understanding of what they mean before they are fully explained. As soon as students are told that 'F' stands for force, 'a' for acceleration, and 'm' for mass they will remember that they wrote down $F = ma$ and be prepared to hear the teacher tell them that force is equal to mass times acceleration.

Graphic Organizers

Definition:

Graphic Organizers are visual representations that help students draw connections between the knowledge, ideas, and concepts of a given topic. They are a visual way of structuring information, or arranging important aspects of a concept or topic into a pattern using labels. Graphic organizers fall into a variety of categories:

- Descriptive – Usually a central idea or theme with branches extending from it. Ex: spider maps, fishbone maps, descriptive map, problem and solution map
- Classifying/Categorizing – Anything that can show what category something falls into or a hierarchy of a group of related things. Ex: charts, trees, Venn diagram
- Sequencing – Arrows are used to show sequential processes usually connecting states or actions. Ex: series of events chain, cycle, problem-solution outline, human interaction outline, sequential concept map
- Compare/Contrast – Allows for the comparing and contrasting of information. Ex: compare-contrast matrix, continuum scale
- Part to Whole – Shows how pieces of something come together to make the whole, usually stressing how the parts must interact. Ex: bracket map, puzzle map

Benefits:

Students that are highly visual learners usually benefit a lot by using graphic organizers. They are beneficial to all students when trying to understand any system with interconnections.

Application:

Any unit that has multiple parts can be organized using a graphic organizer.

Examples:

Visual representation of an engine cycle:

