Volume 2
Issue 3

P.O.S.T.
Preparing Outstanding Science Teachers

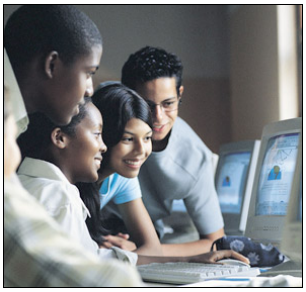
NSTA Resources

Chemistry Comes Alive!
To show the public how exciting chemistry can be, this website from the Journal of Chemical Education features things that explode, glow, sputter, spin, and change color. Produced at the University of Wisconsin-Madison, the site has videos of such phenomena as ice bombs, dust explosions, and beating hearts made of mercury, all demonstrating basic concepts in chemistry. Visit *www.jce.divched.org/JCESoft/CCA/Pirelli.*

Star Light, Star Bright
In this online activity, students in grades6-9 explore the nature of the electromagnetic spectrum. Students identify the different properties of waves and the relationships that exist among energy, eavelength, and frequency. They will correlate images taken by the Hubble Space Telescope and other astronomical instruments to the wavelength, color, and temperature information thatcan be found in the spectrum. An educators guide accompanies the activity at *http://amazing-space.stsci.edu/resources/explorations/light*.

National Science Digital Library's Middle School Portal

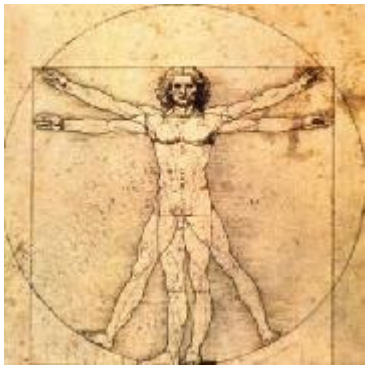
Three important cycles-nitrogen, water, and carbon-are examined in the online series *What Goes Around Comes Around*, found on the NSDL's Middle School Portal. For each cycle, introductory text offers an overview, stressing the human impact, then links to high-quality lesson plans and classroom activities as well as rich sources of content information for teachers. The series appear in the Explore in Depth section of the portal.
Another section, Quick Takes, offers several just-in-time resources for teaching a topic or for expanding content knowledge.
Teachers can browse the Middle School Portal collection by subject lists that align with national standards and search by keywords at www.msteacher.org/science.aspx



Smithsonian resources aligned with state curricula

The Smithsonian website offers an updated teaching tool, one that features access to more than 1,300 education resources aligned with standards of learning in every state. Users enter their state's name into the search engine at www.smithsonianeducation.org/educators/index.html to find lesson plans, virtual exhibitions, photographs and artwork, and databases of research information that apply directly to their state curriculum in a particular subject at a given grade level.

These activities and more can be found in NSTA Reports at the National Science Teachers Association website.



Vee Maps: An alternative to the traditional laboratory report

A Vee map is a tool that guides students' thinking and learning during laboratory experiences. It was developed in the 1970s to help instructors and students understand the purpose of scientific laboratory work and to help students understand the process of constructing their own knowledge during laboratory experiences. Since its development, the Vee map has been successfully used in a variety of secondary science settings.

The general structure of the Vee map is shown in Figure 1. This representation is a simplification of the original Vee map design. The six areas included in the Vee maps—focus question, word list, concept map, events, data and analysis,
and conclusions—are interrelated and represent the production of knowledge. The focus question is in the center of the Vee map and guides the laboratory experience. A focus question must be clearly stated, address a concept, and require the collection of data. Depending on the laboratory experience, teachers either provide students with a focus question or have them determine their own.

Once the focus question is identified, students create a word list that relates to the question. Students are encouraged to work together to identify words, but sometimes teachers provide key words or ideas. From the students' word lists, a teacher can quickly assess their level of understanding of the topic and if they have the required background knowledge to engage in the laboratory experience.

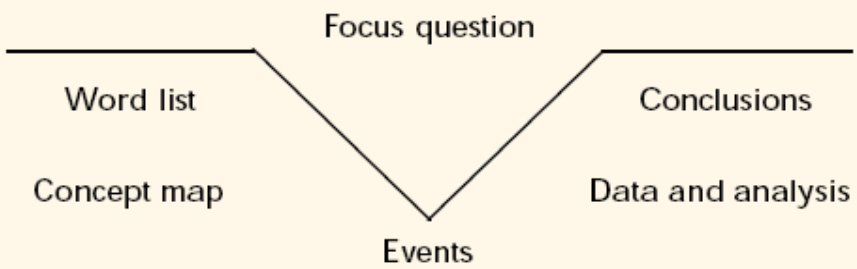
Below the word list, students construct a concept map using the mentioned terms. By creating a concept map, students begin to understand the relationship of the terms to one another and to the focus question. As students proceed with their laboratory experience, and as they begin to understand the concept addressed through the laboratory, students are encouraged to modify their initial concept map.
At the bottom of the Vee map is the events area. In this area, students write out the procedure or draw the laboratory setup that will be used to answer the focus question. The importance of details should be stressed in both writing and drawing and emphasize that another student group should be able to follow the procedure based on the information provided.

In the data and analysis area, on the right side of the events area, students record their collected data and an appropriate analysis. Students design the format of their data tables prior to conducting the experiment. When the data collection is complete, students analyze their data and include the pertinent graphs, charts, and tables. Sometimes they realize there are problems with their research plan or collected data.
When this happens, encourage them to address the problem and revise their investigation. It is important to allow students to do this, just as scientists often revise their experiments to improve their data collection.

In the upper right side of the Vee map, students report their conclusions based on the laboratory experience. Require students to draw conclusions based on the data, suggest implications of their findings, and state additional unanswered questions that are evident from the experience. Often students realize they need to collect additional data to draw a better conclusion, and if there are no time constraints, we allow them to collect additional data. But if time is limited, they just state the limitations of the laboratory experience in their conclusion.

FIGURE 1.

Vee map components.



Vee Map Use

Vee maps can be used in place of any laboratory report. Furthermore, a teacher can easily vary the degree to which students are involved in writing Vee maps. For example, a teacher can provide students with the focus question or the laboratory procedure to guide them in a specific direction. Alternatively, a teacher can allow students to develop their own questions or procedures. Ultimately, the degree of student involvement depends on the instructional goals of the teacher.

Vee maps can be used in conjunction with extended-inquiry activities . Prior to introducing the Vee map, students can participate in a brief laboratory experience that introduces concepts, explores scientific techniques, or creates a discrepancy in students' minds. At the beginning of a kinetics lesson, for example, students can dissolve different substances in water and give an explanation for observed phenomena. From this experience, students generate researchable questions that become focus questions. Students then work in groups to develop word lists, concept maps, and events. All students are expected to participate in the collecting and analyzing of data, which is recorded in the data and analysis area. Students can work in their groups or individually as they write conclusions. Each area should be approached before a group can proceed to the next. The Vee map in Figure 2 represents the work of a student in an extended inquiry activity that addressed kinetics. One can easily see that the Vee map reveals student thinking and easily fits on a piece of notebook paper.

To facilitate the assessment of student Vee maps, a Vee map rubric can be developed. By using a zero- to four-point scale for each area, the Vee map rubric can provide summative (the grade received) and formative (the improvement needed) information about a student's performance. In addition, the rubric can reveal areas that need to be modified by the teacher during classinstruction. For example, we found that students were scoring low on graphically representing their data. As a result we modified our curriculum to include laboratory activities in which students learn the difference between continuous and discrete data, and thus the appropriate use of a line graph or bar chart.

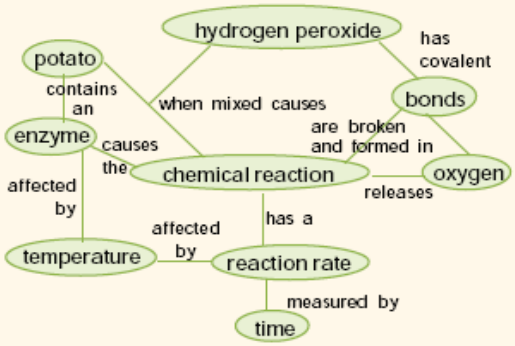
FIGURE 2.

Student-generated Vee map.

Focus question: What is the effect of temperature on the reaction between potato pulp and hydrogen peroxide?

Word list: oxygen, chemical reaction, temperature, potato, hydrogen peroxide, reaction rate, enzyme, bonds, time

Concept map:



Events:

1. Measure 5 mL of potato pulp and 5 mL of hydrogen peroxide.
2. Place in different water baths 10°C, 20°C, 30°C, 40°C, 50°C, 60°C.
3. Measure the height of the foam after 5 minutes.

Conclusions: At cold temperatures (12°C and 22°C) a very slow and very minimal reaction occurs; foam rises 1–2 cm. At 31°C and 38°C a rapid reaction occurs, and the foam rises to 10 cm. At 52°C and 63°C no reaction occurs. The enzyme in the potato pulp functions slowly in cold temperatures and does not work at high temperatures. This experiment should be repeated to find the perfect temperature for the enzyme to work. Other variables, such as pH, should be investigated for optimal enzyme activity.

Data and analysis:

Temp. °C	Height of foam in cm	Time
12	1	5 min
22	2	5 min
31	8	5 min
38	10	5 min
52	0	5 min
63	0	5 min

Why Vee Maps Work

First, Vee maps provide a format for students to construct their knowledge about a science concept. Students can see how scientific knowledge is developed through the process of reflecting on what they know and the investigation they undertake. This occurs as students reflect on the left and right side of the Vee map as they try to answer their focus question. Providing students with an opportunity to build their knowledge about science concepts is essential in constructivist learning theory (Driver et al, 1997; Fosnot, 1996), and the *National Science Education Standards* states that students should learn about the nature of science (National Research Council, 1996). Ultimately, these documents reinforce the need for active learning environments in which students are cognitively engaged with science ideas and the manner in which science develops.

Second, Vee maps can reveal the process by which a student constructs knowledge. Teachers can identify the prior knowledge of a student through the word list. The data and analysis area can show teachers how students support their claims or hypotheses, while the conclusion section demonstrates the level of students' understanding. As a student progresses through each of these areas, the teacher can modify instruction and curriculum to meet each student's need. Traditional laboratory reports typically do not provide this much information.

Third, Vee maps can be graphical formats that foster communication. As the Vee map is constructed, students working in groups talk with one another to develop each area. They need to agree on selected words and events and decide how to analyze data. In this setting, students can socially construct their knowledge with peers. The teacher can then move among the groups and effectively assist each group in developing their knowledge.

Portions of this article appeared in the Jnauary 2001 edition of the NSTA journal **The Science Teacher** under the title "Versatile Vee Maps" by Gillian Roehrig, Julie A. Luft, and Mary Edwards.

Try Engineering

Each month, one of the many lesson plans available on TryEngineering.org will be profiled. The "Simple Machines" activity explores the different types of simple machines and shows students how to identify them. They also learn that simple machines require human energy in order to function, and how some machines incorporate many simple machines in their design. Topics examined include levers, inclined planes, wheels and axles, and pulleys.

Students examine several everyday items to determine whether they are simple machines. Students also have the opportunity to complete the "jumping coin" activity to find out where to push on a lever to get the best lift. Another optional activity in the lesson is one where students build their own inclined plane. The lesson provides step-by-step instructions for both educators and teachers. All lessons on TryEngineering.org provide detailed teacher and student handouts and worksheets, many which can serve as pre-activity homework assignments. Explore this, and other lessons online at www.tryengineering.org/lesson.php.