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Human body outline
Human body outline with pulse points
Human body parts
Data tables
Graph paper

INTRODUCTION

Science, Tobacco & You was produced by the Center for Integrating Research and Learning at the National High Magnetic Field Laboratory at Florida State University to promote science in the elementary classroom. By providing teachers with resources and a context in which they can be used, the Center attempts to increase science literacy in the multi-disciplinary classroom. Tobacco and health-related issues are the context for this curriculum resource, which was funded through the Department of Health, Office of Tobacco Control.

The curriculum package consists of the following:

- Teacher/Student Guidebook
- Science Modules and Activities Manipulatives Package
- Web-based resources (http://scienceu.fsu.edu)
- Interactive CD-ROM
- Training and Promotional Video

Teacher/Student Guidebook: is located on the Website and can be downloaded in its entirety or in part, depending upon your needs. You can adapt the Guidebook so that it is appropriate for your students. Consisting of 9 modules and 22 activities, the Guidebook is set up so that each module and activity is consistent with the others, so you will know exactly where to look for the features that you need.

Modules contain from two to four activities each depending upon the Module focus. Each Module has introductory information, which states the purpose for the module and tells you what to expect from the activities. All activities have the following features:

- Teacher Background: Content information specific to that activity.
- Activity Instructions: Materials, General Overview, Homework, Assessment, Standards, and Extensions. Extensions are research-oriented and include strategies for incorporating music, art, literature, mathematics, social studies, and other areas.
- Student Page: Includes background for students and instructions for the activity.

The front material includes information on how to use the materials, health and safety-related issues regarding the materials, the processes of science, and how to create graphs and tables, as well as the use of other visual organizers.

An appendix is included that provides you with blackline masters supporting the activities, graph paper to be xeroxed, and sample data tables. A master reference list is provided, as well as an annotated bibliography of literature that can be incorporated to support and enhance the activities.

Manipulatives Package: Equipment to support all 22 activities. Each package contains the following materials:

- 10 rolls of masking tape
- 15 cups with holes
- 15 pieces of vinyl tubing
- 150 balloons

- 15 latex squares
- 15 small rubberbands
- 15 large rubberbands
- 1 box coffee stirrers
- 8 stopwatches
- 8 stethoscopes
- 500 tokens
- 50 pouches
- 30 lung bags w/mouthpieces
- 1 5-quart pail
- 2 boxes alcohol wipes
- 15 tape measures
- 1 copy <u>How Your Body Works</u>

Web-based Resources: Web resources are designed to support and enhance the activities that you do in your classroom. They can be used with the activities or on their own, and consist of the following:

Navigation Help

- Looking and Thinking
  - Virtual You: What are the effects of tobacco on your body?
  - Virtual Lab: Scientifically explore the tobacco issue
  - Tobacco: Past, Present and Future: Take an historical look at tobacco
  - Ad Smart: Become an informed consumer
  - Cool Me: Be the coolest you that you can be
  - Avoid or Break the Addiction: How can you stop the tobacco trend?
  - Tobacco and You: Investigate the effects of tobacco on you, the economy and the environment
- Teacher Resources
  - Bulletin Boards: Teachers post and answer curriculum-related questions
  - Journals: Teachers exchange curriculum ideas
  - Lesson Plans: Teachers share successful lesson plans
  - Guidebooks: Download the most recent Science, Tobacco and You Activities
  - Program Updates: Information concerning the Science, Tobacco & You Projects
- Asking and Sharing
  - Bulletin Boards: Students post questions
  - Journals: Students share ideas
  - Frequently Asked Questions: Posted answers of the most frequently asked tobacco-related questions

Also included is a nutrition database that lists hundreds of food items with nutritional details.

CD-ROM: Further support for the Modules, the CD-ROM provides graphics and interactive opportunities for teachers and students.

- The Virtual U: Students scan in their own images to see how they change over time with and without using tobacco.
- Virtual Body: Focuses on physical and mental health.
- Community Research Lab: Students identify and study the social and personal risks associated with tobacco use.
- Teacher's Area: Access to the Teacher/Student Guidebook; management tools to determine students' use of the CD-ROM activities.

HOW TO USE THE MATERIALS

The activities were designed to be completed in the order that they appear in the Teacher/Student Guidebook. However, depending upon the level of content knowledge on the part of your students, you can pick and choose which activities you use. You are encouraged to read through the entire guidebook before beginning the activities; certainly you will want to read each activity carefully. Some activities require advance preparation or gathering or xeroxing resources. Many activities can be expanded to whole units or mini-units.

Although each activity has multiple strategies and suggestions for homework assignments, you are the best judge as to whether you wish to use these.

Activities are supported by the website and the CD-ROM. Although they can be completed without these resources, students will get the greatest benefit from the combination of materials.

It is recommended that students will keep a **Science Notebook**. By recording their thoughts, predictions, observations, data, interpretations, conclusions, answers to questions, and further questions to which they will seek answers, students will learn about the processes of science. How you handle the Science Notebook is up to you. You may wish to have students keep it as part of a looseleaf book, a separate spiral-bound book, a composition book or a folder. Notebooks can be graded periodically; you can pick them up at random from time to time, or look at all notebooks at certain intervals. Real-world scientists use notebooks to communicate with others, as well as to create evidence of what they have done. When your students keep science notebooks, they are acting like scientists, which is a form of authentic assessment. Each Student Page references the Science Notebook and each activity uses the notebook for assessment.

OVERALL HEALTH AND SAFETY ISSUES

The safety of your students during any activity is a primary concern. You and your students should be aware of safety at all times. You will find safety issues for each activity throughout the guidebook. In activities where potential safety problems may arise, you should be aware of the appropriate steps to take for preventing injury or any type of harm. You should clearly discuss health and safety issues with students before beginning activities.

Certain physical conditions that some students may possess can cause complications when completing some activities. You should be well aware of student health history before beginning any of these activities. The following health issues should be considered through out each activity.

ASTHMA, HYPERVENTILATION, AND OTHER RESPIRATORY CONDITIONS

Students with asthma should have parental consent to participate in any physical exercise for various activities. It is recommended that any student with a severe respiratory condition refrains from participating in those modules involving exercise or deep breathing.

If hyperventilation or an asthma attack occurs during any activity, contact the school nurse or other authority immediately.

DISINFECTING

All materials that are to be shared among students, such as stethoscopes, mouthpieces, and tubes, should be disinfected using a 10% bleach solution as outlined in the disinfecting instructions before Module 1. Bleach is not allowed in the classroom; it should be stored elsewhere. Cleaning solution should be mixed and used outside of the classroom. There are products that you can use in the classroom that do not contain bleach. Check with your county science contact. Adequate ventilation should be provided when mixing bleach solutions. Antiseptic (alcohol) swabs should be used to wipe ear pieces of stethoscopes after each student's use.

SENSITIVE ISSUES

In doing certain paired (partner) activities, sensitive issues involving touching or feeling other students may arise. Teachers should provide close supervision of students when performing these activities. Emphasize to students the importance of respecting one another and of following strict instructions during such activities.

PROPER USE OF MATERIALS

Any material in a laboratory or classroom when used improperly can be a potential health hazard. Read all warning labels before introducing a material into the classroom. You should be aware of potential allergies to latex or other ingredients. Familiarize yourself with symptoms and warning signs as well as first aid. It is recommended that you have easy access to a first aid kit in case of emergency. Contact the school nurse with any emergency and report all accidents to the proper authority.

STORAGE OF MATERIALS

Improper storage of materials can lead to damage of the materials or harm to students. All hazardous materials such as bleach, antiseptics, and glues should be stored out of student reach. Containers should be clearly labeled. Instruments (stethoscopes) and other materials should be kept in their original containers to avoid damage.

ACCIDENTAL INGESTION OR EXPOSURE

Proper care should be taken to avoid ingestion of hazardous materials. If ingestion does occur, the school nurse should be notified immediately. If bleach is swallowed DO NOT INDUCE VOMITING. Give the student large amounts of water. Call the Poison Control Center (1-800-282-3171) immediately, and then notify the school nurse.

Some materials are small enough to be swallowed and pose a choking hazard. All students should be discouraged from placing materials into their mouths unless instructed to do so.

LATEX WARNING

People with skin allergies or those who may be sensitive to rubber latex should not touch the latex squares used to assemble the diaphragm model (activities #2 & #11). Extended exposure to latex, as with any substance that may potentially become an antigen, can lead to acquiring a sensitivity to latex or latex proteins in some individuals. "Irritant contact dermatitis" cannot be prevented by wearing gloves. For people with questions about allergic reactions, or with a history of them, a consultation with a dermatologist, allergist or immunologist is advised before coming in contact with latex or rubber objects.

10% BLEACH SOLUTION

After each use of the mouthpieces, make sure they are sanitized by cleaning them in a 10% bleach solution for about 10 minutes. (It is okay to leave them overnight.) Fill the bucket with 2.5 quarts or 10 cups of water and add 1 cup of bleach. This will give you a 10% bleach solution for sanitizing . Be sure to rinse the mouthpieces thoroughly before use. Reminder: Objects should be totally submerged in the solution. Bleach is not allowed in the classroon; it should be stored elsewhere. Cleaning solution should be mixed and used ouside of the classroom. There are products that you can use in the classroom that do not contain bleach. Check with your county science contact.

WHAT IS SCIENCE?

Science is more than facts about the world in which we live–it is a systematic study of the things and events that occur in our world and universe. Scientists presume that through the use of intellect (and oftentimes aided by instruments and technology) people can understand the nature of the world and universe (SFAA, 1990). Science is an intellectual and social endeavor that involves making observations of a phenomenon (either in the field or in a laboratory), recording data, drawing conclusions from data, and developing theories to explain the phenomenon. Science doesn't "happen" in isolation–scientists interact with peers. They exchange information with other scientists about experimental techniques and equipment to allow others to replicate experiments in an attempt to validate observations and conclusions (Benchmarks, 1993, AAAS).

Scientific ideas are open to revision when new observations challenge prevailing theories. Scientific ideas are modified as new information is made available to and accepted by scientists after careful scrutiny. There is always the possibility that at some point in the future, a new thought will replace what has been accepted up until that time. However, change in scientific thought usually happens very gradually, and much of the main body of scientific knowledge is stable for long periods of time.

A SCIENTIST WRITES ABOUT SCIENCE

John R. Miller, *Scientist at the National High Magnetic Field Laboratory*

Science is more than just knowledge. It is a discipline that allows organization of knowledge for effective use. Without discipline, knowledge is little more than tricks or gimmicks to entertain, but with it, we can build what others might only imagine. As the word discipline implies, there can be much hard work and many long hours involved in earning the title scientist (and it really never ends), but the belief that we are doing and creating things for a better world provides a tremendous sense of fulfillment.

I view science as a means for service. I like to believe that sometimes this can be service to the local community, but more often it's service to mankind in general. The real benefit may not be realized for some time. In science, we try to understand nature with enough certainty that we can use that knowledge effectively to make life better – for ourselves and for all those who will come after us.

To a scientist, certainty means being able to establish precise, predictable, and quantitative relationships among natural features and phenomena. For example, anyone can say with some certainty, "If you drop a rock it will fall to the ground." A scientist will say, "If you drop a rock from a height of 100 feet, it will hit the ground in 2.5 seconds," and if you want more precision, he (or she) will take into account the wind, the latitude, and the altitude to improve upon that prediction.

A SCIENCE EDUCATOR WRITES ABOUT SCIENCE

Angelo Collins, Ph.D., *Professor, Vanderbilt University, Nashville, Tennessee*

1. What is science? Science is the way we come to understand the natural world. Scientists observe the world around themselves and ask why. Scientists use tools to seek answers to their questions. Some of the tools scientists use are actual, such as rulers and microscopes. Some of the tools they use are virtual, such as the design process for a controlled experiment. When scientists think they have a possible answer to their questions they do a number of things. They check to see if they understand more science ideas. They try to convince others that their solution is a good one. They try to apply their solution in a new situation. And they ask another question.

2. What does it mean to "do science" in the classroom? Doing science in a classroom can be hard work for teachers, students and parents. Recently, in the United States, we have come to think of doing science as 'hands-on' activities. But people do not learn with their hands. What is needed in classrooms is 'minds-on' activities. In such activities, students ask questions; they seek answers to their questions through observation or experiment or reading or interview or any number of ways; they generate, organize and make generalizations from data they have collected; and they convince others of the value of their solutions. When a classroom activity provides opportunities for students to do all of the above, it is called a full inquiry. However, to learn to design an experiment, the students may respond to a question the teacher has posed or to learn to organize data, they may respond to an experiment someone else has designed. Teachers of science are always caught in a tension between teaching to understand ideas of science and inquiry in science. Memorizing big words is not science, unless students inquire into the

origin and use of the ideas represented by these big words. Since understanding science takes time, students usually come to understand only a few ideas. It is important to focus on ideas in science that are important – that can be useful in many circumstances. However, neither is doing inquiry science unless students attain some understanding of science ideas through the inquiry activities.

3. How do you distinguish "reliable science" from "unreliable science?" For me, the reliability of science is associated with its usefulness. If an idea in science can be used to explain and predict a number of related natural phenomena, then it is reliable. However, I believe that students in elementary school need to learn science that is both reliable and canonical. Canonical means that the understanding that students attain is consistent with that of the scientific community. Consistent with does not mean as extensive as.

4. How can teachers use questions (theirs as well as their students) to guide science in their classrooms? Teachers of elementary aged children are frequently concerned about teaching science. They frequently recall science as an esoteric subject with big words and complex, expensive equipment done by people in special places called laboratories. Teachers of science to elementary children need to imagine science as an exciting way to seek answers to questions. They need to be keen observers of the natural phenomena in their classrooms. They need to be adept at pointing out natural phenomena in the classroom, school and community. Their most frequent questions will be questions like: Did you notice...? Why do you think that happened? How could we find out why? Seeking the answers to these questions becomes the grounding of the science lesson.

A FIFTH-GRADE STUDENT WRITES ABOUT SCIENCE

Justin, *Tallahassee, Florida*

> Science depends mostly on who you have for a teacher. I have a cool teacher who lets us do science a lot. We try to figure out how things work. Sometimes we get it, sometimes we don't. Sometimes [our teacher] doesn't even know how to do it!

FAMOUS SCIENTISTS ON SCIENCE

Richard Feynman (1918-1988), *Nobel Prize-winning physicist and perpetually curious individual*

> What is science? The word is usually used to mean one of three things, or a mixture of them. I do not think we need to be precise - it is not always a good idea to be too precise. Science means, sometimes, a special method of finding things out. Sometimes it means the body of knowledge arising from the things found out. It may also mean the new things you can do when you have found something out, or the actual doing of new things.

Alexander Graham Bell (1847-1922), *invented the telephone and founded Bell Telephone Co.*

> Great discoveries and improvements invariably involve the cooperation of many minds.

Claude Bernard (1813-1878), *French physiologist; called the founder of experimental medicine*

> The true worth of a researcher lies in pursuing what he did not seek in his experiment as well as what he sought.

Jacob Bronowski (1908-1974), *English historian, mathematician, and writer*

This is the essence of science: Ask an impertinent question and you are on the way to a pertinent answer.

John Burroughs (1837-1921), *U.S. author and naturalist*

To treat your facts with imagination is one thing, but to imagine your facts is another.

Albert Einstein (1879-1955), *Swiss-German-U.S. physicist, credited with developing the theory of relativity.*

I think and think for months and years. Ninety-nine times the conclusion is false. The hundredth time I am right.

Stephen Hawking (1942-), *British physicist; he used the idea of "black holes" to explain universal physical laws in A Brief History of Time.*

There is no prescribed route to follow to arrive at a new idea. You have to make the intuitive leap. But the difference is that once you've made that intuitive leap you have to justify it by filling in the intermediate steps.

It often happens that I have an idea, but then I try to fill in the intermediate steps and find that they don't work, so I have to give it up.

Peter Medawar (1915-1987), *British zoologist. He discovered that immunity is acquired in the embryo, and won the Nobel prize in medicine for work on immunity and skin grafts.*

Among scientists are collectors, classifiers, and compulsive tidiers-up; many are detectives by temperament and many are explorers; some are artists and others are artisans.

Maria Mitchell (1818-1889), *first U.S. professional astronomer; she discovered a comet in 1847.*

We especially need imagination in science. It is not all mathematics, nor all logic, but it is somewhat beauty and poetry.

Isaac Newton (1642-1727), *English mathematician who described laws of motion and gravitation.*

If I have ever made any valuable discoveries, it has been owing more to patient attention than to any other talent.

Florence Nightingale (1820-1910), *English nurse and reformer. She introduced improved nursing practices and used research to improve the nursing profession.*

Were there none who were discontented with what they have, the world would never reach anything better.

J. Robert Oppenheimer (1904-1967), *U.S. physicist who headed the atomic bomb development team at Los Alamos, NM.*

There are children in the streets who could solve some of the top problems in physics, because they have modes of sensory perception that I have lost long ago.

Louis Pasteur (1822-1895), *French chemist and bacteriologist. He proposed the germ theory of infection; developed food sterilization called "pasteurization."*

In the field of observation, chance favors the prepared mind.

James D. Watson (1928-), *U.S. biochemist with Francis Crick and Rosalind Franklin, he established DNA's molecular structure for which Watson and Crick won the Nobel Prize.*

Science seldom proceeds in the straightforward logical manner imagined by others. Instead, its steps forward (and sometimes backward) are often very human events in which personalities and cultural traditions play major roles.

SCIENTIFIC INQUIRY IN THE CLASSROOM

Children are born with a sense of wonder about their world that is characteristic of scientists. This is evident in the questions they ask about their world and how it works: What is thunder? Why is the sky blue? Where do birds go in the winter? Why are some flowers red and others yellow? What distinguishes children from scientists is children lack the knowledge of how to answer their questions. An understanding of these and other issues can come from personal investigation. School can provide the opportunity for students to ask and answer their own questions under the guidance of a teacher who understands how to design and conduct experiments and gather and analyze data.

INQUIRY SCIENCE INSTRUCTION

A vision for Science Education stated in the National and State Standards is that all students become scientifically literate as they enter the 21st Century. The Teacher/Student Guidebook with Modules and Activities represents our efforts to assist teachers as they make this happen. The guidebook contains 9 modules and 22 inquiry-based and hands-on activities. The message reflected in these activities is that we can assist students to become better consumers of information concerning tobacco products and be prepared to meet the demands of the 21st century. These activities contain topics that are focused on the human body and the systems that are affected if a person is a consumer of tobacco products.

Inquiry-based science instruction in the elementary classroom includes the processes of science: observation, inference, and experimentation combined with scientific knowledge and critical thinking skills. Students use critical thinking and scientific knowledge as they observe the natural world to develop an even deeper understanding of science. These activities encourage students to develop the ability to think critically, ask questions, develop strategies to answer their questions, and communicate their findings in a variety of ways. Inquiry-based instruction does require that the learner have opportunities to explore the content. Then students can develop questions about the subject. This means they will have to manipulate equipment, read, use the internet, interview, ask questions of others, and document their observations to develop an understanding so they can pose questions. Current research in teaching and learning says that more information is retained when students are given opportunities, support, and encouragement to explore their own questions.

Hands-on instruction differs from inquiry in the following ways:

- Hands-on instruction does not always have a critical thinking component.
- Hands-on instruction may not utilize the student's ideas for shaping explorations.
- Hands-on instruction and inquiry-based instruction can be performed

together or separately. In other words, hands-on instruction does not guarantee inquiry.

- Hands-on activities provide students with opportunities for exploration and manipulating equipment so that further questions may be generated.
- They provide students with opportunities for observing, documenting those observations, measuring, recording, interviewing or drawing conclusions.

READING AND WRITING IN SCIENCE

Reading and writing is an integral component of any science curriculum. Science in the real world requires communication of research results, dissemination of information, and synthesis of findings. Included in all modules are opportunities for students to read and write about the various concepts addressed. Reading and writing about issues in science stimulate thinking, encourage participation, and motivate students to become responsible consumers of information (Dickson, 1995). While doing research, reading, and writing about science, students improve reading comprehension and writing skills.

Reading in Science

Reading should not be limited to factual, nonfiction material just because it is being done in the context of science. There is a great deal of well-crafted fiction and nonfiction material written for children that can enhance any science program by introducing students to alternative ways of thinking about science concepts. Different techniques are necessary for the different types of materials, however, and when reading from technical literature, it may be necessary to guide students' reading until they are comfortable on their own. Learning strategies such as outlining, concept mapping, and highlighting main ideas can be used to help students with expository reading. When reading fiction books, with a little practice, students will quickly become adept at distinguishing between science facts and fiction. These activities provide suggestions for both fiction and nonfiction books which can be used to enhance activities, extend student thinking, and reinforce concepts. They also include reading experiences that address specific reading benchmarks of the Florida Sunshine State Standards, and to prepare students for the types of challenges found on the Florida Comprehensive Achievement Test (FCAT).

Writing in Science

Being able to share results and ideas with others through writing is a dynamic process that happens every day in science. The portrayal of science as a body of information or a collection of facts to be memorized inhibits the writing of understandable research reports, readable biographies, nonfiction accounts of scientists, or fictional stories. Writing of any sort extends students' learning of science as they articulate concepts. Further, presenting results of an experience or knowledge to others requires a great deal of confidence, which can be gained from believing you have accurate information.

Included in these activities are opportunities for students to write about what they have learned in a variety of ways. While research writing is an important science skill, students often resist when assigned to write reports and respond with sterile and stilted compositions (Matz, 1990). Therefore, writing activities that add the elements of self-reflection and creative imagination are included. Writing activities are also geared to provide students with experiences designed to address specific writing benchmarks of the Florida Sunshine State Standards and promote the effective use of the writing process consistent with Florida Writes!

Journal writing and reflective writing are two ways for students to clarify their thinking and articulate science concepts. These techniques also provide the teacher with unique insights into how students learn and what they are learning. Throughout the modules students are encouraged to maintain their Science Notebooks. The notebook is a way for students to take notes, express themselves, clarify ideas, criticize their own thinking, and reflect on ideas. Science notebooks also provide a record of data collected, questions to be answered, and serve as a ready reference for subsequent inquiries.

In addition to the notebooks, teachers are encouraged to offer students varied writing opportunities such as:

- Letters and email to other students in the school or in remote locations to share science-related experiences, to request information from scientists, to write persuasive letters about scientific or social issues, or write to legislators and public figures who affect public policy;

- Picture or easy reading books written and published by students to introduce scientific concepts to younger students;

- Poems and skits about the topic being studied, to personalize the information or concept learned through the expressions of the affective domain;

- Stories, using a variety of techniques and representing a variety of genres, for example, science fiction or fantasy based on scientific ideas, life in the future, life and creatures from prehistoric times, life in a different environment, imaginary creatures and distant worlds;

- Other writing opportunities include creating Web pages, fact books, guidebooks, manuals and video productions; and writing newspaper or magazine articles, editorials, interviews, dictionaries, technical reports, posters, and advertisements. These writing experiences will draw students into the inquiry process and lead to understanding and internalizing of new ideas.

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STATE AND NATIONAL STANDARDS, FCAT, TERRA NOVA, AND FLORIDA WRITES!

The Teacher/Student Guidebook contains Modules and Activities that support State and National Standards. Activities and Extensions support the Florida Comprehensive Achievement Test (FCAT), Terra Nova, and Florida Writes! The Modules and Activities support science, language arts, social studies, mathematics, health, visual arts, dance, and physical education through a variety of teaching strategies incorporating inquiry and hands-on activities.

Activities, Extensions, and Homework use critical thinking skills and analysis of scientific data. By communicating the results of their data collection through a variety of writing strategies, including mathematical explanations, students are preparing for the FCAT, Florida Writes!, and Terra Nova. National and State standards are referenced in each Activity; particular exercises that prepare students for standardized tests are identified.

GRAPHIC ORGANIZERS, GRAPHS, AND DATA TABLES

Graphic Organizers

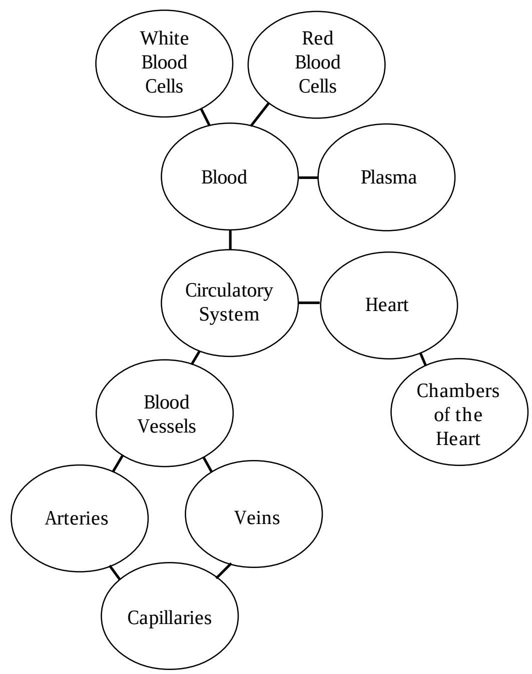
As part of the activities, students will be asked to create graphic organizers to help them arrange ideas in ways that make sense to them. Graphic organizers can be powerful tools to create visual pictures of information to help students see patterns and relationships. It has been said that a picture is worth a thousand words. This is especially true for graphic organizers. A good graphic organizer can facilitate a holistic understanding of complex concepts by illustrating at a glance the key parts of the whole and their relationships. Graphic organizers are particularly useful as prewriting tools for students to use for organizing their thoughts.

There are many types of graphic organizers. They include webs, Venn diagrams, matrixes, concept maps, and others. The type of organizer to be used depends on the nature of the relationships that need to be illustrated. The following are some examples of graphic organizers and descriptions of how they can be used.

Webs

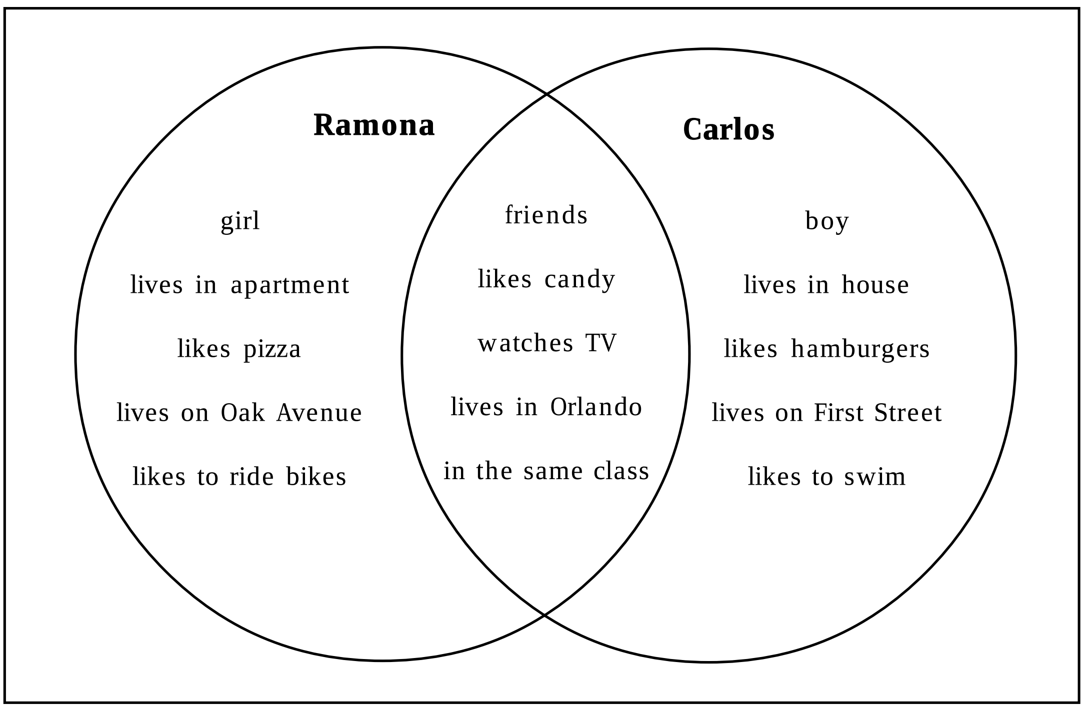
Webs are used to describe a central idea. Webs can be things, processes, or concepts. In language arts they could be used to analyze the traits of main characters in literature. In mathematics they could be used to identify attributes of geometric shapes. In social studies students can use webs to analyze cultural traits. In science they can be use to identify properties of objects. Webs are particularly effective visual tools for brainstorming sessions with your students.

Parts of the Circulatory System Web



Venn Diagrams

Venn diagrams, developed by John Venn of Cambridge University, are used to describe and compare two or more things in terms of identifying attributes that are similar and different. Venn diagrams consist of intersecting circles that illustrate how things, people, places, events, or ideas are alike or different. They identify and isolate those characteristics that are shared and those that are not shared.

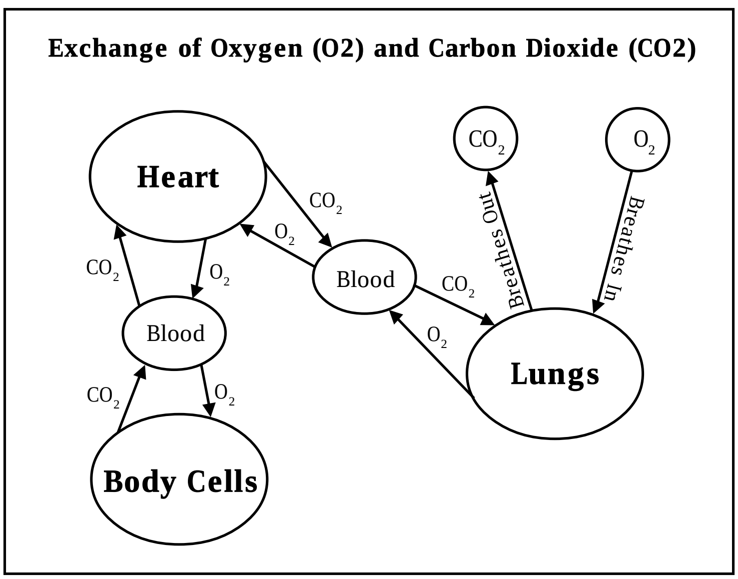


Student	Height	Weight in lbs.	Resting Heart Rate Breaths Per Minute	Quiet Breathing Rate Beat Per Minute
Amanda	4’11”	103	85	22
Carlos	4’10”	101	87	24
Ramona	4’8”	94	84	21
Jesse	4’10”	96	86	23
Monica	5’0”	108	85	22

Matrix: **Comparing Heart and Breathing Rates**

Matrixes

Matrixes are essentially tables with rows and columns that are used to show similarities and differences between two or more things. Matrixes are particularly useful for comparing many things and many attributes at the same time.



Concept Map: **Gas Exchange**

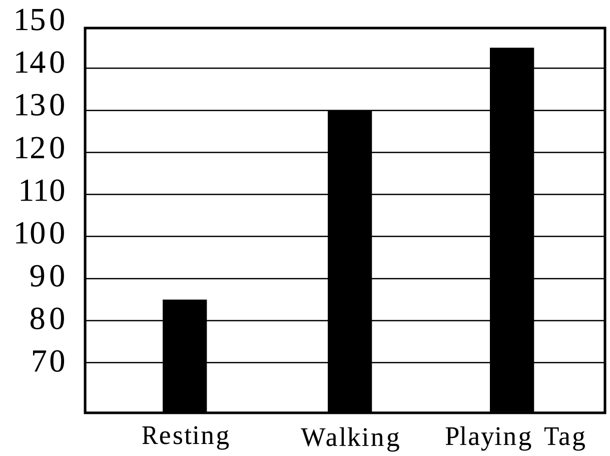
Concept Maps

Concept maps are special types of webs used to map, organize, or describe the thinking process and complex relationships. Like simple webs, concept maps are used to identify related concepts and subconcepts. However, with a concept map, the links between the various cells are labeled to describe the nature of the relationships. Arrows can be used to describe the direction of the relationships. The relationships between concepts can be read like a sentence. These additional features make concept maps useful and effective in graphing relationships, which are complex.

Graphing

Competence in graphing skills is necessary for a number of activities. Students will be asked to record, manage, and display information (MA.E.2.2). They will be given opportunities to learn to use graphs as tools to create pictures of relationships.

One of the skills needed to construct graphs is organizing data in tables. Organizing data into tables helps students see patterns in the data and makes it easier to construct graphs.



Constructing a Data Table

When you make a record of what you observe, the information is called data. Measurements of time, temperature, volume, and rates are examples of data. There are no absolute rules for constructing data tables. However, the manipulated variable is usually recorded in the left column, and the responding variable is recorded in the right column.

Activity	Heart Rate (BPM)
Resting	85
Walking	130
Playing Tag	145
Playing Basketball	170
Playing Soccer	180

A manipulated variable is the one the experimenter changes in order to observe a response to the change. For example, the data table above is a record of measured heart rates after a variety of activities. The manipulated variable is an activity and is recorded in the left column. Heart rate is the responding variable and is recorded in the right column.

Constructing a Bar Graph

Using a well-organized data table makes constructing a bar graph much easier for students. Students can use the information to construct a bar graph similar to the one shown above, which is based on the heart rate data table. Students can use graph paper to construct the bar graph. The first step is to label the axes. The convention is to use the horizontal axis for the manipulated variable and the vertical axis for the responding variable. However, these may be reversed. The FCAT recognizes either way of constructing the graph as acceptable.

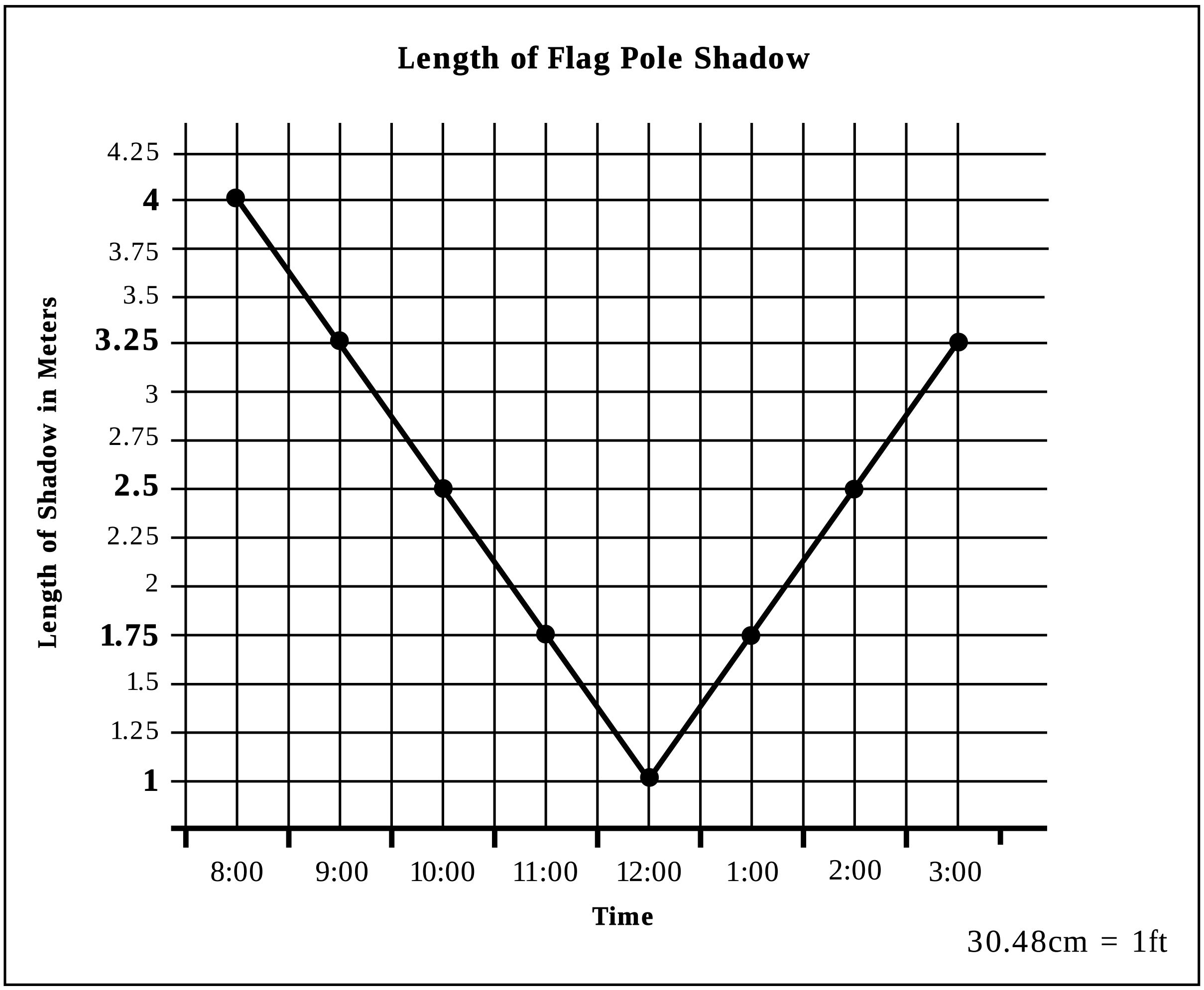
The next step is to determine an interval scale that is appropriate for the data to be graphed. In the case of heartbeats per minute, an interval of 20 beats is appropriate for illustrating changes and trends. The final step is to plot and draw bars with the designated lengths.

Constructing Line Graphs

A line graph is the best way to represent a continuous change in data. For example, a line graph might be used to show how the length of a flagpole shadow changed from one hour to the next during the day. Students would construct a data table as shown in the example. Graph paper should be used to construct the line graph. The axes are drawn and labeled and appropriate intervals indicated as in the example. Points are then plotted to represent the two related sets of data, and a line is drawn to connect the points. If measurements of the shadow were made every hour, these points would be plotted and straight lines drawn between the points. There is an assumption with a line graph that even though the only real data points are those that are plotted, the line between points represents implied data.

Time	Length of Shadow in Meters
8:00	4
9:00	3.25
10:00	2.50
11:00	1.75
12:00	1
1:00	1.75
2:00	2.50
3:00	4

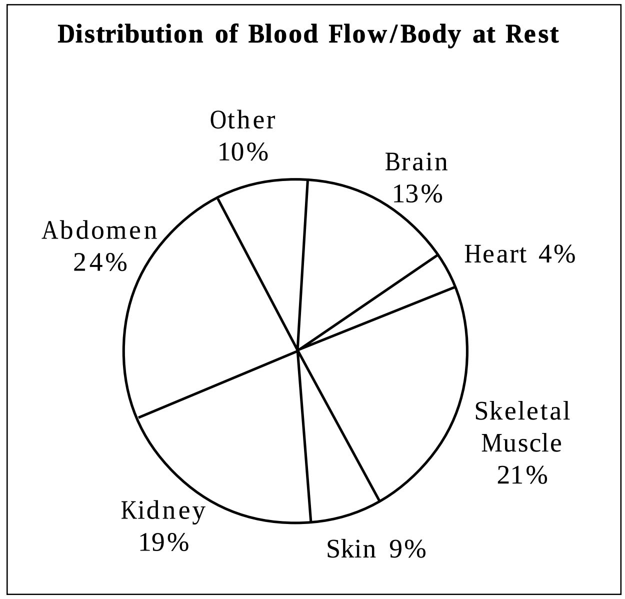
Line Graph



In the example, a shadow did exist at all times, and its length did not jump or drop from one plotted value to the other. It changed continuously and gradually as suggested by the graph. Therefore, a student could use the graph to infer the length of the shadow at times other than when measured.

Circle Graphs

Circle or pie graphs are used when a total amount has been divided into parts and the interest is in the ratio of each part to the whole and not so much in the particular quantities. For example, the circle graph to the right shows a comparison of the amounts of blood flow to various parts of the body. Pie graphs can be made from computed percentages. To do this the numbers in each category are added to form the total or whole. By dividing each of the parts by the whole with a calculator, numbers between zero and one will result. If rounded to hundredths, these numbers are now percentages of the whole. Check that the total is 100 percent since rounding may cause some error. Using a compass, ruler, and protractor a circle graph can be constructed. This requires an understanding of the relationship between percentages and the degrees of a circle. Each 18 degrees of a circle represents 5 percent, 36 degrees represents 10 percent, 90 degrees represents 25 percent, 180 degrees represent 50 percent, and so forth. It is worth noting that computer software programs are available to produce a variety of graphs. Circle graphs are included in almost every computer spreadsheet and graphing program.



Circle Graph

Using Computer Software to Construct Graphs

Computer software that quickly converts numeric data into graphs is one of the most powerful uses of the computer in the classroom. Graphing software typically creates pie charts, bar graphs, and line graphs from any sets of data that are entered. Most spreadsheet programs have graphing capabilities. Both *Microsoft* and *PerfectWorks* spreadsheet programs have easy to use graphing capabilities. The Science, Tobacco & You CD-ROM includes a graphing application. Graphing programs are powerful teaching tools because they demonstrate changes in the graphs very quickly with different changes in the data to be plotted. Students' attention can be focused on understanding and interpretation of graphs and relationships without having the task of constructing the graphs. Most programs allow several line graphs and curves to be plotted on the same axes in order to make contrasts and comparisons.