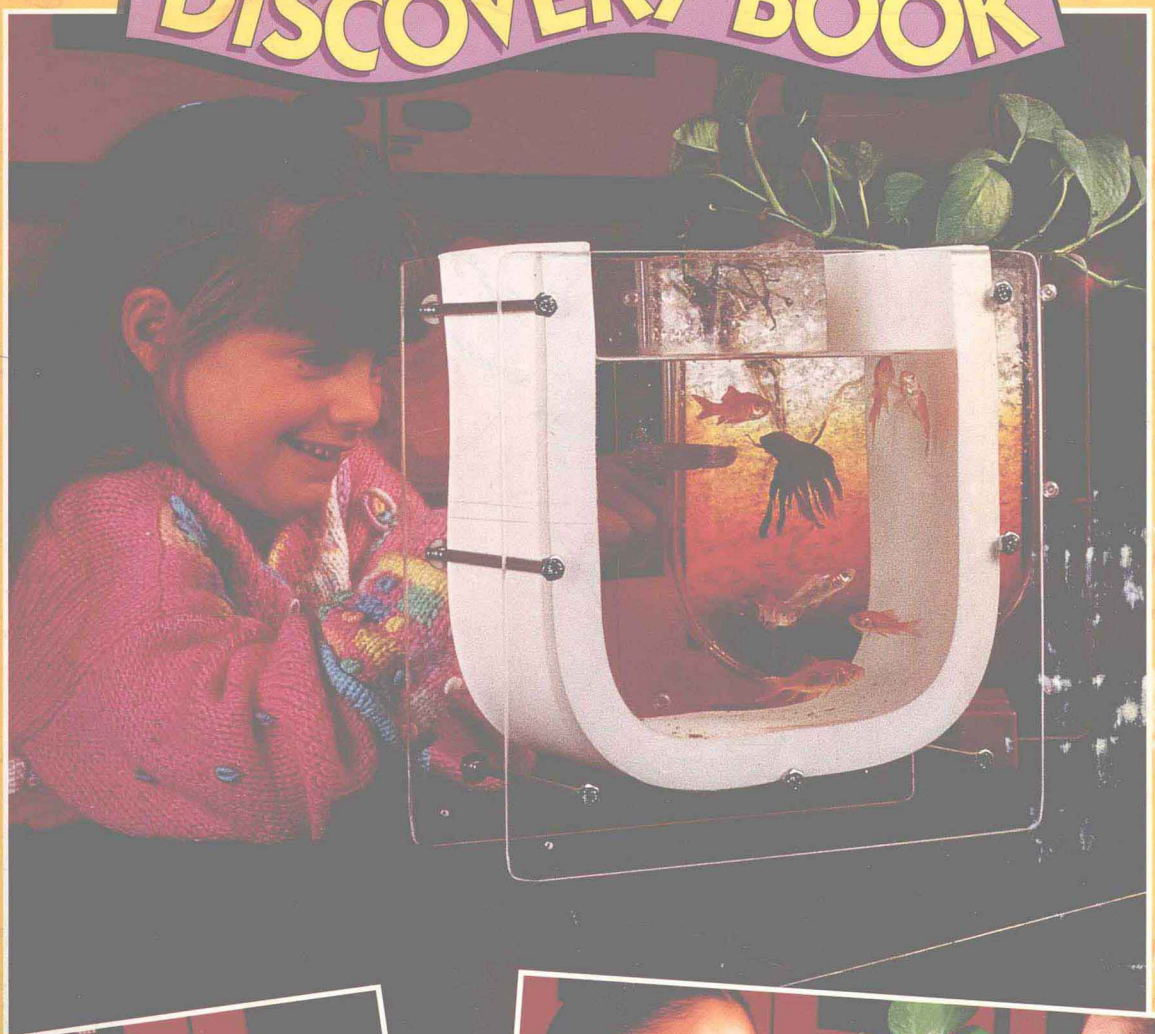
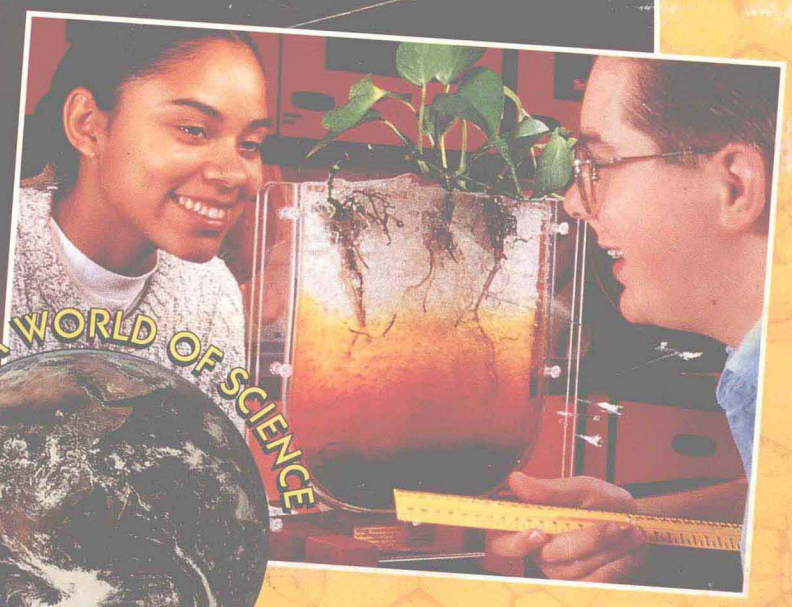
THE TEACHING TANK™

DISCOVERY BOOK





DISCOVER A WORLD OF SCIENCE

VOLUME 2

THE TEACHING TANK ™

DISCOVERY BOOK

VOLUME TWO

Published

by

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THE TEACHING TANK™ DISCOVERY BOOK

VOLUME TWO

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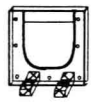


Preface

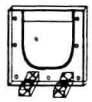
THE TEACHING TANK™* DISCOVERY BOOK, Volume Two** continues the tradition of clearly defined and easy to use science lessons. The basic design of **Volume Two** is the same as in **Volume One**, but we have added two short sections, ***Emphasized Skills and ***Application to the Real World*** to allow you to quickly see the relevance of the concept that is being investigated. These new sections along with the popular ***Thinking Questions*** and ***Teaching Notes***, which clarify and give additional information, will provide the background for a successful investigation. The ***Materials*** section and easy to follow ***Procedure*** section provide the "nuts and bolts" of the lesson and virtually guarantee a lesson that is easy and fun too!

THE TEACHING TANK™ and ***THE TEACHING TANK™*** DISCOVERY BOOKS are designed to stimulate students so that they can experience what science is, by allowing them to do what a scientist does. The lessons are not only observational, they are specifically written to foster student hands-on experimentation. They are also written covering a variety of levels with an inquiry approach to discovery learning, specifically stressing the science skills of observing, measuring, calculating, interpreting data, formulating hypotheses, controlling variables, and experimenting. The use of this book and ***THE TEACHING TANK™*** creates a more exciting, and very visual way, for teachers to demonstrate a science principle or for students to actually complete the investigation themselves safely.

The lessons in this book have "educational versatility" in that they can be utilized from Kindergarten through College. The same experiment could easily be modified by teachers for their particular science lesson objectives and needs. This book is perfect for Homeschool families and parents who want to share the excitement of science with their children. This discovery book is not intended to be a complete science curriculum, but it will add excitement to your lessons, enhance student learning, integrate science disciplines, motivate students, lessen discipline problems, and stimulate creative and critical thinking skills.

In the past, students were asked to view and perform experiments in small test tubes or beakers. These students were very limited as to what they could actually observe due to the size, shape, and visual distortion of those small containers. Teachers were also having a very difficult time. They were trying to perform classroom demonstrations for the whole class using these same small containers. There was a need to develop a product that would be larger in size, exhibit greater visual clarity, and have good depth of vision. ***THE TEACHING TANK™*** is that product. It is the perfect teaching tool for every science classroom. Students are able to explore more and receive immediate feedback, literally "right before their eyes". The large double-sided viewing surface gives students on both sides of the tank the same directly observable science experience.

THE TEACHING TANK™ is a unique science teaching tool with a set of characteristics all its own, there is no other such teaching tool on the market today. The **DISCOVERY BOOKS** are the perfect companions to the Tank and will help you discover how easy and fun doing science can really be.



Warning to Teachers and Parents

The experiments in this book have all been tested and are safe when the procedures are strictly followed. Adult supervision and eye protection are always necessary when allowing children to use chemicals in any science investigation. Children/Students should never be left unsupervised while conducting a scientific experiment or demonstration. Always insist that safety goggles are worn for eye protection by all (children, students, and adults). Teachers and adults should always try each science experiment prior to having children complete it. Any chemical spills should be cleaned up immediately. Always wash with plenty of water if any of these chemicals come in contact with skin. The chemicals used in these activities are relatively safe for adults and children to use.

The activities developed for The Teaching Tank are designed to be completed within a class period unless otherwise noted. The tank should then be thoroughly cleaned and made ready for the next activity. **Timely cleaning will prevent unnecessary residues from forming and prevent subsequent damage to the tank**. If the recommendations in the ***TEACHING TANK***™ DISCOVERY BOOKS are not followed, Captivation Inc. will not be responsible for damage to the ***TEACHING TANK***™.

PLEASE BE ADVISED:

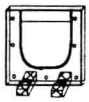
CAPTIVATION, INC. has placed the following **Warning** on the ***TEACHING TANK***™. It should not be removed.

WARNING:

ALWAYS WEAR SAFETY GLASSES.
USE UNDER ADULT SUPERVISION.
USE ONLY AS RECOMMENDED IN MANUFACTURER'S MANUAL(S).
NO OTHER USE OR SUBSTANCES AUTHORIZED.

AUISO:

SIEMPRE HAY QUE USAR ANTEOJOS DE SEGURIDAD,
USELO BAJO SUPERVISION ADULTO.
USELO SOLAMENTE COMO RECOMMENDADO EN MANUAL(ES) DE FABRICATE.
NO HAY NINGUN OTRO USO O SUBSTANCIAS QUE ESTAN AUTORIZADO.



News and Testimonials

Captivation, Inc. has a World Wide Web Page!
http://www.tchg.com
Your Teaching Connection!

The Teaching Tank has been expanded! An expansion kit is now available to use with several of the lessons in this book. Just replace the rubber tubing spacer with the expansion spacer and you are all set. To get a good seal with the expansion spacer put a very light coat of vegetable oil along the side of the spacer where it touches the tank.

Testimonials

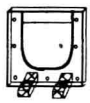
"As the Science Curriculum Facilitator in our school, I have ordered The Teaching Tank for use in grades Readiness through five. It is rewarding to watch students of all ages and abilities become mesmerized as they observe science up close through the transparent tanks." - Marie Ross, 1995 NH Elementary Science Teacher of the Year.

"I have been home schooling my son for four years and science was not the easiest subject to teach. The Teaching Tank and book have been a tremendous help. The lessons are concise and easy to follow. Its list of supplies needed for each experiment, simple to follow steps, and expected results have allowed us to get excited about science. The lessons are designed to keep the child's / student's interest and also opened ended to keep them thinking. We have had such fun and can't wait for Book II. Thank you so much."
- Charissa Hammond, Oakdale, Connecticut

"The Teaching Tank was a refreshing way to motivate my students in science. The Teaching Tank has allowed me to integrate various science concepts into my thematic units, as well as extended activities from existing curriculums. If you are looking for an easy way to spark interest, create dialogue, and enrich comprehension, The Teaching Tank is for you!" - Maria M. Clark, Teacher, Londonderry School District

"I was very excited when I discovered The Teaching Tank this past August while working on a science project in New Hampshire. I have been using it now for several months in my visits to schools, teacher workshops and with my Royal Academy home school children. It is an outstanding invention and one that can be used over and over again to teach many lessons that touch upon all areas of the science curriculum. The Teaching Tank reaches across all grade levels. Parents would find it both a valuable and fun teaching tool." - Gordon Corbett, Science Consultant / Workshop Presenter

"I used The Teaching Tank for my 7th grade Science Fair project. The tank allowed first hand observation of my experiment with plant root growth. It made the project fun and exciting and a real learning experience for me and other students in the school." - Hillary Jordan, 7th grade student, Woodbury School



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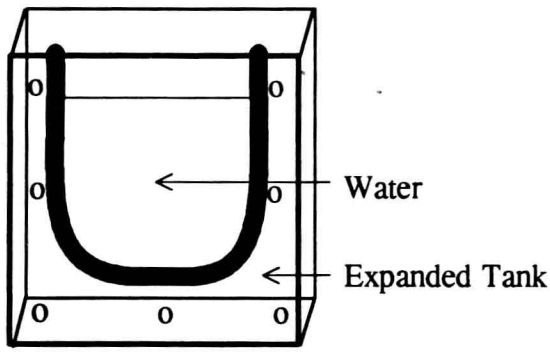
Blue Sky, Orange Sunset

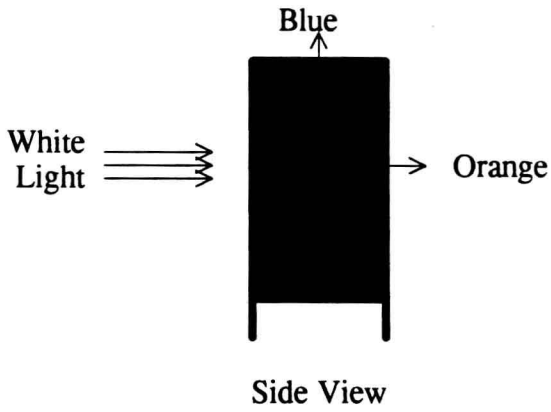
Objective: To have the students determine the why the sky is blue and the sunset is orange.

Emphasized Skills: Observation, problem solving, predicting.

Application to the Real World: This illustrates why the sky is blue and the sunset is orange. It is also why the rainbow always displays the colors in the same order.

Materials: White Light Water Milk
Expanded Teaching Tank





Side View

Procedure:

1. Fill the expanded tank with water.
2. Shine a bright white light directly into the face of the tank. A strong flashlight, film projector light, or other strong source will do.
3. Observe the color of the light coming out on the opposite side of the tank and coming out directly above the surface of the water at the top of the tank. (Initially there shouldn't be any color observed.)
4. Add 1/4 cup of milk to the water in the tank. Observe the opposite side and top. Continue adding milk and checking for color.

Thinking Questions:

Would a red light work?

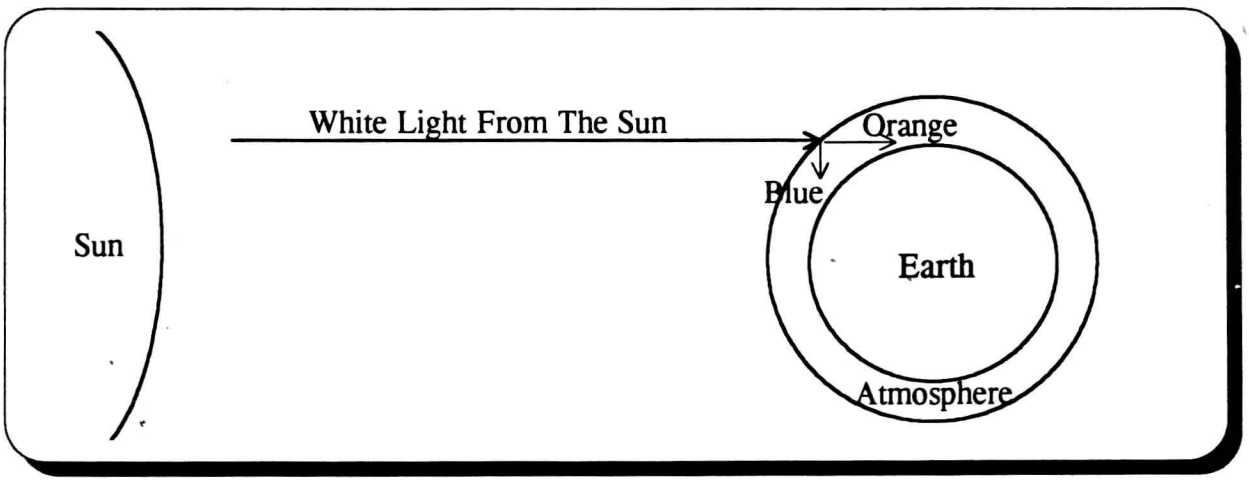
How else can colors be separated from white light?

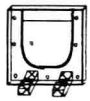
What happens when too much milk is placed into the water?

Could you use something besides milk and get the same effect?

Teaching Notes:

As light hits the particles of milk in the water, its path is changed. The shorter blue light is changed more than the longer orange light. The blue light is scattered more than the orange light. The orange light continues in a straight line through the tank while the blue light is scattered. That is why an orange tint is observed directly across from the white light and a blue tint is observed looking down from the top of the tank. During a sunset, the white light from the sun is traveling through a lot of the earth's atmosphere, the orange comes through and the blue is scattered away. See the diagram below.





Bullboat

Objective: To have students determine how the shape of a vessel can determine the amount of cargo it can carry. To show students how a vessel displaces its weight and that of the cargo in water.

Emphasized Skills: Experimentation, modeling, problem solving, comparison.

Application to the Real World: The amount of water displaced by a vessel will equal the weight of the vessel and cargo combined.

Materials: Expanded Teaching Tank Marker or Grease Pencil Tap Water
Marbles or Glass Beads Ball of Plasticene Clay

Procedure:

1. Fill the Tank with tap water to about two inches from the top.

2. Carefully mark the level of the water. Label it level #1.

3. Drop a ball of clay into the water. A ball about the size of a golf ball should be good, but the size of the ball is not critical. You may want to experiment with various size pieces. Mark the new level of the water and label it level #2. The difference represents how much water your clay displaced.

4. Using all of your clay shape it into a canoe or boat design. Warm up your clay first by rolling it around in your hands. It will now be easier to work with. Try to get your boat to float. Check the water level again and label it level #3.

5. Now try to load your craft with the marbles and see how many you can place into it before it sinks. As you load down to the water line you will want to be very careful. Keep your boat trimmed properly. Record how many marbles you were able to load before it sank. Just before you think it is going to sink note the water level again.

6. Now shape your clay into as large a bowl as you can and repeat steps four and five.

Thinking Questions:

The clay displaces water as it is placed into the tank. Why did each of the floating vessels, when empty, displace more water than the ball of clay?

Which vessel held the most marbles? Why?

Which vessel was easier to keep trim? Why?

Why do cargo ships have such a broad beam (width) on them?

Deep cargo holds on a vessel would be better than shallow ones. Why?

What is center of gravity? Why is it important in this investigation?

If you were riding your bike and had to transport a heavy pack would you want it loaded down on the bike itself or up on your back? Why?

How can a loading officer know how much of his ship is below the water? Why is this important?

Teaching Notes:

The ball of clay and the vessels weigh the same. However, each vessel displaced more water than the ball because they were larger in shape as they rested in the water. Therefore, there was a stronger force pushing up against the two vessels. The strongest force was pushing against the bowl shape and that is why it floated so well even with a larger cargo of marbles.

The amount of water displaced equaled the weight of the vessel and cargo combined. This principle was worked out by the Greek scientist, Archimedes, who lived over 2000 years ago.

The American Indians who lived on the western bank of the Mississippi and Missouri rivers built a boat on the bowl design called a "bullboat". The frame was made of lashed together red-willow sticks and buffalo hides stretched over them. They were then stitched together with buffalo sinew. It usually took three skins to finish a bullboat which was then caulked with buffalo fat. They could carry a large cargo, but were clumsy to maneuver. Eventually the canoe became the vessel of choice because of its ease of handling.

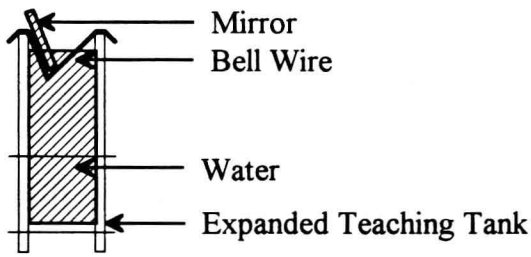
Color, Light, and Spectrum

Objective: To have students determine that light is made up of different colors and that each color has a range of wavelengths and its own spectrum.

Emphasized Skills: Data collection, measurements, observation, problem solving.

Application to the Real World: Rainbows are the result of water droplets in the sky acting as a giant prism.

Materials: Expanded Teaching Tank, Tap Water, Paper Towels, Hand Held Square Mirror, Sheet of White Paper, Tape, Two Pieces of 12" Stiff Bell Wire, Colored Sheets of Plastic for each Color of the Spectrum ROYGBIV



Procedure:

1. Set the Teaching Tank up in direct sunlight from a window and fill with tap water. Early morning or late afternoon sun is best while the sun is low in the sky. The Tank should be set far enough from the window to make a large enough spectrum on the paper.

2. Tape the sheet of white paper on the wall next to the window. (This step is unnecessary if you have a white wall.)

3. Now position the mirror in the Tank so as to project the spectrum onto the white paper. This might take some adjusting. The wedge of water between the mirror and the surface of the water acts like a prism.

4. Using the bell wire make a sling or cradle to rest the mirror in this fixed position. Again you will need to do some adjusting. Let the water settle down.

5. Now you should see the colors ROY-G-BIV. Wiggle your fingers in the water and watch the colors blur and become white.

6. Let the water settle down again. Then one by one, from red to violet, place a piece of plastic between the sun and the mirror and observe the spectrum of each color on the sheet of paper or wall.

Thinking Questions:

Why does the mirror and water act like a prism?

What does a prism do to the light waves?

Light is made up of different colors. What famous scientist discovered this?

Why were the spectrums of each color different?

Does this investigation have any connection with rainbows?

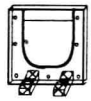
Teaching Notes:

White light is made up of all colors. The prism bends each color by a slightly different amount. Red has the longer wavelength and is bent the least. Violet has the shorter wavelength and is bent the most.

When you stirred up the water the wavelengths blurred and of course became white.

Each color consist of a wide range of wavelengths. That is why you got a different spectrum from each color when you placed the plastic sheet in between the sun and the mirror.

The more wavelengths that are absorbed into an object the more energy is absorbed. A white shirt on a sunny day will reflect the suns energy and remain cool. A dark colored shirt will absorb a lot of energy and will become very warm. This is why people near the equator would choose white or lighter colored clothing over dark clothing.



Convection Cells

Objectives: To have students create a working model of a convection cell. To have them understand what a convection cell is. To help the students determine where, in nature and otherwise, convection cells are found.

Emphasized Skills: Observation, problem solving, modeling, recording.

Application to the Real World: Convection cells are found in thunder storms, ocean currents, home baseboard heating systems, etc.

Materials: Teaching Tank, Tap Water, Sheet of White Paper, Scotch Tape, Two Eye Droppers, Sheet of Black Paper, Two Stick-On Fish Tank Thermometers, Red and Blue Food Coloring

Procedure:

1. Using the Scotch tape cover one half of one side of the tank vertically with the white paper and the other half with the black paper.

2. Fill the Tank to within ½ inch of the top with tap water. Let the water settle down. Place a thermometer on both the black and white sides of the Tank about half way from the top. Record the temperature.

3. Place the Tank in direct sunlight near a window so that the Tank will be able to absorb a lot of solar energy. The paper should be opposite the sunlight so that the suns rays pass through the Tank and water.

4. Carefully inject (do not squirt) a drop or two of the red food coloring with one of the eyedroppers into the water on the white half of the Tank near the gasket and about two inches deep.

5. Repeat step four using the other eyedropper and switch to the blue food coloring. Inject it carefully into the Tank on the black side.

6. Make observations as the sunlight shines into the tank. Be patient. It will take a little while for the water to absorb the solar energy. Take note of the temperature.

7. Pay particular attention to both food dyes and which way they are moving.

8. Compare the temperature of the backside of the Tank with your hand. Make sure you check both the white and the black halves. Do this carefully so as not to disturb the water inside the Tank.

9. Take note of your thermometer readings and compare them to when you started.

10. Add some more food coloring as instructed above. Continue observations.

Thinking Questions:

The sun gives off different kinds of energy. Which one of them is driving this experiment?

Which side of the Tank has the highest temperature readings? Why is this so?

Which side had a current that was moving downward? Why? What is the current doing on the opposite half? Why? What is the result of these two flows? What word best describes this movement?

Why are the two colors mixing? What color is the result and why?

If you did not use the black and the white paper what do you think would happen? What if you only used black? What if you only used white?

Air and liquids are both called fluids. Where in nature might you have a movement of fluids like this? Where in your house?

Teaching Notes:

If it is a rainy or snowy day or you would like to do this experiment after the sun has gone down, a spot light or a 100 watt bulb trained onto the Tank from eight to ten inches away will work perfectly well. Of course the spotlight works better than the 100 watt bulb because you can direct the energy better.

Dark colors absorb more of the suns light and heat energy than light ones. Black absorbs the energy best of all and white the least.

As the sunlight streams in it is absorbed into the black side of the Tank and heats up the water more quickly than the white side. In fact the white side is reflecting a great deal of the energy back out of the Tank.

This sets the stage for convection. The water warms up (black side), expands, becomes less dense and then rises. Cooler water (white side), more dense, sinks.

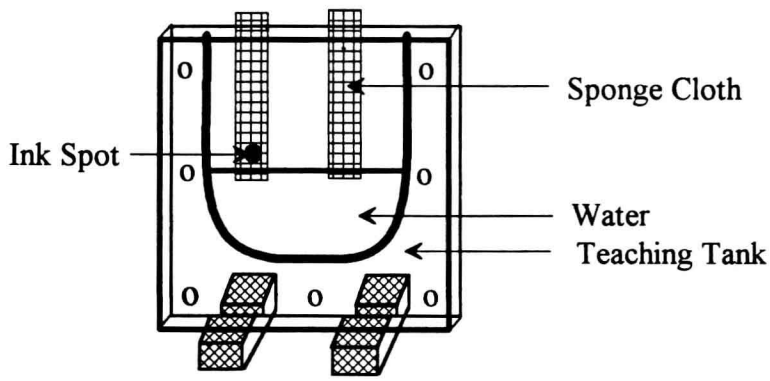
See Appendix A for more explanation and examples.

Objective: The students will measure the height that water will climb up an absorbent material.

Emphasized Skills: Data collection, measurements, application to common experience.

Application to the Real World: Sponges, paper towels, etc. all are absorbent materials used everyday.

Materials: Teaching Tank, Tap Water, Two Clothespins, Black Water Based Marker or Pen, Watch or Timer, Yellow Sponge Cloth (Kellogg Brand)



Procedure:

1. Cut two 1½ inch strips from the sponge cloth. Let them dry completely until they are stiff. Measure and record their exact length.

2. Set up the Teaching Tank with water level six inches from the top.

3. Insert one strip into the tank until it just touches the water. Keep the quilted pattern toward you. Use a clothespin to hold it in place. Note the time. Observe and record what happens to the sponge and to the water.

4. Place a large wet dot of black ink on the second strip and place it into the tank so that it just touches the water (don't let the dot of ink touch the water). Observe and record the movement of the ink.

5. Flick the top of the sponges with your finger. Since they are dry they will make a definite sound.