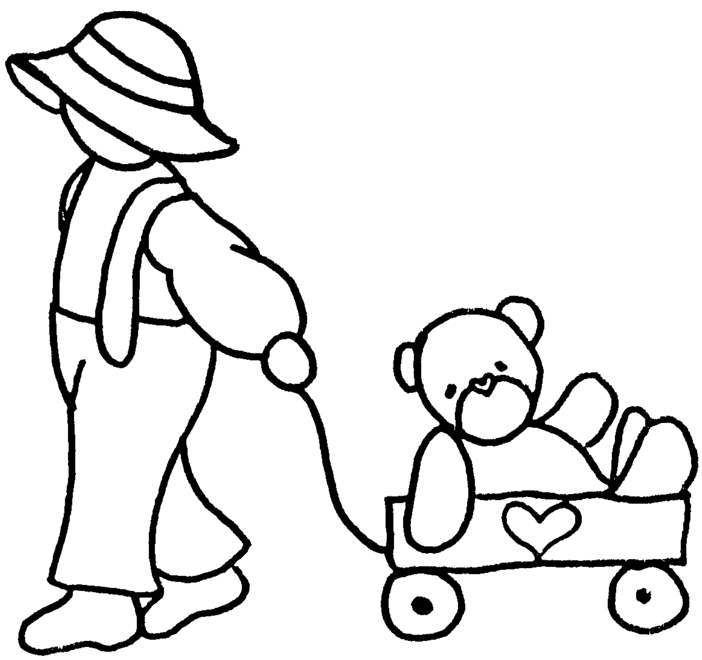
Applied Science

Our Technological World

SECOND GRADE

SCIENCE AND MATH



3 WEEKS

LESSON PLANS AND ACTIVITIES

APPLIED SCIENCE
OVERVIEW OF SECOND GRADE

SCIENCE AND MATH

WEEK 1.
PRE: *Exploring perception.*
LAB: *Experimenting and predicting volume, weight, and length.*
POST: *Estimating and gathering data.*

WEEK 2.
PRE: *Comparing and contrasting two and three dimensional objects.*
LAB: *Recognizing and comparing shapes.*
POST: *Exploring unit cells to create patterns.*
WEEK 3.
PRE: *Investigating symmetry.*
LAB: *Comparing symmetry in nature.*
POST: *Discovering tessellations.*

PHYSICS

WEEK 4.
PRE: *Describing the physical world.*
LAB: *Exploring the physics behind toys.*
POST: *Investigating how things work.*
WEEK 5.
PRE: *Comparing different forms of energy.*
LAB: *Investigating different forms of energy.*
POST: *Exploring nuclear, heat, and chemical energy.*

TECHNOLOGY

WEEK 6.
PRE: *Investigating everyday simple machines.*
LAB: *Investigating machines that produce work.*
POST: *Comparing machines that produce energy.*
WEEK 7.
PRE: *Exploring technology.*
LAB: *Investigating computer technology.*
POST: *Comparing technologies used in the entertainment industry.*

BUILT ENVIRONMENT

WEEK 8.
PRE: *Comparing different energy machines.*
LAB: *Investigating how solar energy produces power.*
POST: *Contrasting different forms of energy.*

APPLIED SCIENCE - SCIENCE AND MATH (2A)

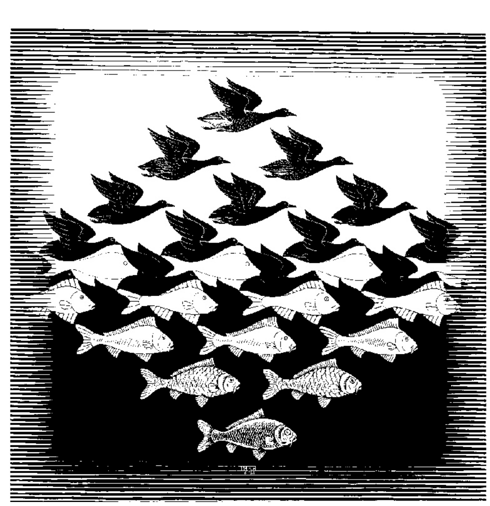
Students observe optical illusions.

PRE LAB

OBJECTIVES:

1. Exploring perception.
2. Comparing and contrasting optical illusions.

VOCABULARY:



circle
diameter
height
line
measure
optical illusion
perception
tall
wide

MATERIALS:

worksheet
Internet
rulers

BACKGROUND:

Science is a subject that teaches many principles required throughout your student's life. It helps develop critical thinking skills that can be used in many situations. Students should begin to learn that the world can be seen many different ways and that there is often more than one explanation. There is not always a correct answer in science because many times the answer changes with new information. There can also be more than one answer depending on the tools used to derive the answer.

Mathematics is more than just memorizing addition or division. Math is a tool for humans to compare and contrast objects quantitatively. Scientists require math as a tool to help them record and compare their data. Math and science work together to help us understand the world.

Optical illusions can dramatize why scientists must measure and record their observations, repeatedly. Initial conclusions can be proven inaccurate or incorrect when the situation is fully analyzed. The verification of an initial conclusion should be part of how human beings can use critical thinking as a way of living.

PROCEDURE:

1. Perception is how one sees an object or event. Students may have heard "your eyes can play tricks on you," but not understand what it means. In this lesson, students should look at objects and make a judgement about that object. They will find when they measure the object, the answer their eyes may have seen was incorrect. There are 3 pictures: (1) hat, (2) lines, and (3) circles. Ask students the following questions when you show them the pictures.

2. *Hat:* Is the hat wider or taller? After the class answers (take a hand count), ask students if they can explain how they made their decision. Hopefully one of the students will suggest measuring the hat. Instruct several of the students to measure the width and height. They will find out that they are the same. Discuss reasons why this happened. This is an example of our eyes "seeing" the tall hat and disregarding the width.

3. *Lines:* Which of these lines is longer - line AB or line CD? Take a hand count of students and then measure each line. They will find out they are the same. This is an optical illusion caused by the arrows guiding our eyes.

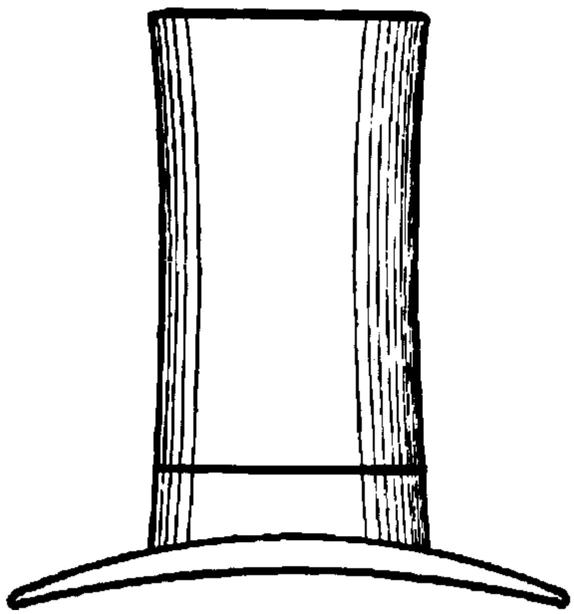
4. Circles: Which center circle is the largest? Again take a poll of the students, and then have them measure the diameter of the circles in the center of each illusion. They will measure the circles as the same size. Make sure that the students know what a diameter is, and have them measure the diameters of both circles to compare. Your eyes are comparing it to the larger circle. The circle on sheet B looks larger because it is surrounded by smaller circles.

5. Sometimes what appears to be true is not! Do not believe all you see. Sometimes you have to question what you are really seeing as opposed to what you think you are seeing. There are many books on optical illusions which you may want to consult. You may want to check the following websites that have some illusions.

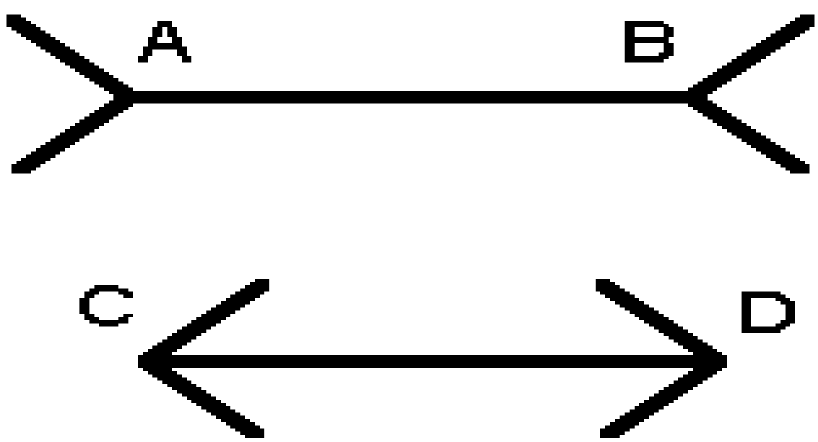
http://lonestar.texas.net/~escher/gallery/

http://www.illusionworks.com/

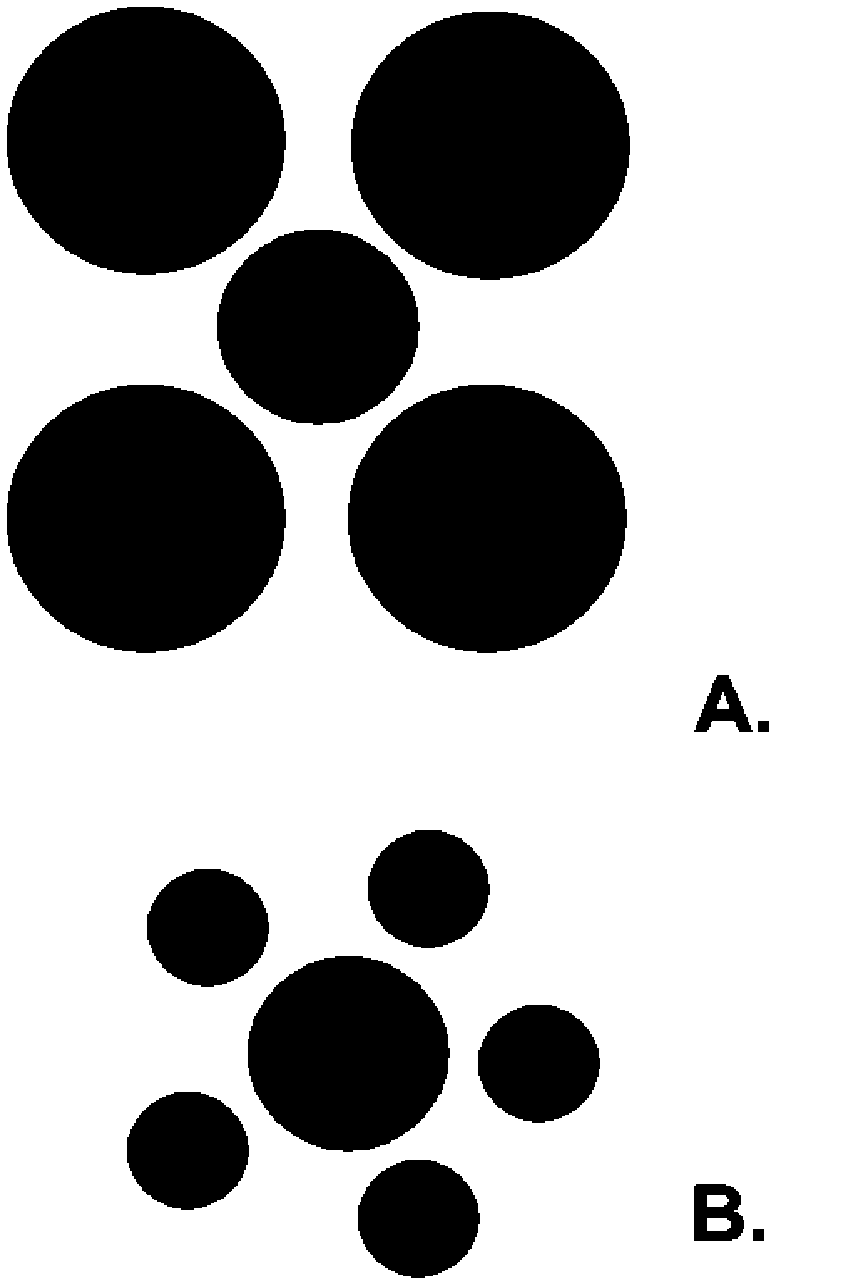
http://www.sover.net/~manx/necker.html



Is the hat wider or taller? Use a ruler to find the answer.
Did your eyes fool you?



Which of these lines is longer - line AB or line CD**?**



Which center circle is the largest?

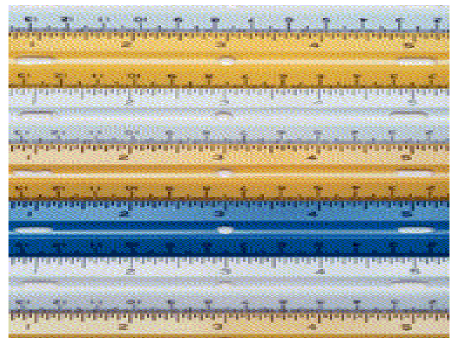
APPLIED SCIENCE - SCIENCE AND MATH (2A)

LAB

Students predict and then measure volume, weight, and length of different objects.

OBJECTIVE:

1. Comparing predictions.
2. Experimenting and predicting volume, weight and length.



VOCABULARY:

estimate
length
predict
volume
weight

MATERIALS:

Applied Science - Science and Math (2A)(or other appropriate materials)
primary balance scale
beakers
water
2 types of yellow candy (one sour, one sweet)
2 liquids - one viscous (like honey) and one less viscous (like oil)
metric rulers

BACKGROUND:

Science and mathematics use the ability to predict or estimate to help guide the experiment or the mathematical conclusion. These skills are learned, and with practice can increase a person's proficiency.

Prediction is based on prior knowledge or familiarity with an event or substance. Predicting what it would be like in space, would require prior experiences with flying on an airplane or riding on some amusement park rides. If a person has not experienced a similar event, prediction is very difficult. The more experiences a child has, the better they will be able to predict an experience.

Estimating is an attempt to determine an accurate answer. For instance, if you are estimating the arrival time of an airplane flying from San Francisco to New York, you would take the time of departure and add about 5 hours. You would also have to take into account a 3 hour difference in time. This information will allow you can estimate time of arrival. An accurate answer would be considered a realistic answer. For example, if you ask a student to estimate the number of beans in a cup and they answer, "20 million," the answer is not accurate. Estimation requires thinking, it is not just any answer.

PROCEDURE:

Many times scientists have to predict the outcome of their experiment in order to design the experiment. In this lab, students will predict or estimate the volume, weight, length, and taste of items without touching them. They will then determine if their predictions are correct by going to each station and actually doing the experiment.

1. Prior to the students doing the lab, set up materials in stations and have the students rotate to each station. Use the enclosed labels to identify the stations. The kit contains some of the materials for each of the stations, but these can be substituted by other appropriate materials. Additional materials such as boxes or household materials are needed to complete the stations. This lab my require two lab periods especially if children have never estimated or predicted before.

PRIOR TO THE LAB:

At each station display the following questions on index cards (enclosed). The cards should have the following set up:

1. VOLUME - WHICH ONE HAS THE MOST WATER?
   Display two glasses, or jars, of different shapes. Fill one with more water than the other. To demonstrate the answer to students you can pour the contents of the jars into measuring cups(need to provide) and measure the quantity in each container.

2. WEIGHT - WHICH ONE IS LIGHTEST IN WEIGHT?
   Display the one large white rock (diatomite), and one black rock (basalt)(in kit). Use the primary balance to find the answer. Try and make the lighter rock larger than the heavier rock. You may want to discuss that although the larger rock may look heavier, it is less dense than the dark rock.

3. LENGTH - WHICH ONE IS LONGEST?
   Display one abalone shell and two types of marine snails(in kit). Provide a ruler for students to measure each sample.

4. WEIGHT - WHICH ONE IS HEAVIEST?
   Display a sand dollar and a mushroom coral(in kit). Weigh them with the primary balance.

5. LENGTH - WHICH IS LONGEST?
   Display 2 animal cut outs(in kit). Measure the width of both with a ruler. Which is widest?

6. SOUR - WHICH ONE IS MOST SOUR?
Purchase 2 types of yellow candy, one sour and one sweet(need to provide). If available, make one sugarless. Allow students to "taste them" to get the answer.

7. VOLUME - WHICH ONE HAS THE MOST WATER?
This station is similar to number 1, but use tall and short glasses instead. Graduated cylinders are ideal(need to provide).

8. WEIGHT - WHICH ONE IS LIGHTEST?
Display the pyrite crystal and quartz geode(in kit). Using a primary balance have students see which mineral is the lightest.

9. LIQUID - WHICH ONE HAS THE MOST COLORED LIQUID?
Display two timers(in kit) To test them, have students flip over both timers at the same time and determine which takes longer to empty. The one with the most liquid will be the last to empty.

10. LIQUID - WHICH ONE IS THE SLOWEST?
Display a jar of honey and another liquid (need to provide). Make sure the lids are tightly closed. Introduce the word viscous. Explain that viscous means thick. Turn the jars on their sides and upside down to observe the movement of the liquids to test the viscosity of the liquid.

2. Discuss length, volume, weight (make sure you discuss heavy and light), liquid, and sour taste.

3. Explain to students that they will move from station to station as a group looking at different things. They will have 2 to 3 minutes at each station. At each station have them predict the answer to each question. They cannot touch anything at this time. Explain that after everyone has made their predictions, they will be able to "test" them.

4. After everyone has made their predictions let the students do the tests at the stations. If it is not practical to allow the groups to do all the testing, the teacher can demonstrate some or all of the stations. Allow up to five minutes per station. Students should record the results of the tests in the corresponding column on their lab sheets. Remind the students that it does not matter if their predictions were correct or not. Science involves learning the true answers. In science we learn from right answers as well as wrong answers.

APPLIED SCIENCE - SCIENCE AND MATH (2A)
PROBLEM: Is it easy to predict something about an item without experimenting with it?
PREDICTION:____

STATION	PREDICTION	ACTUAL
1. VOLUME		
2. WEIGHT		
3. LENGTH		
4. WEIGHT		
5. LENGTH		
6. TASTE		
7. VOLUME		
8. WEIGHT		
9. LIQUID		
10. LIQUID		

CONCLUSION: How many correct predictions did you make?
____

APPLIED SCIENCE - SCIENCE AND MATH (2A)

VOLUME 1. WHICH ONE HAS THE MOST WATER?	**WEIGHT** 2. WHICH ONE IS LIGHTEST IN WEIGHT?
LENGTH 3. WHICH ONE IS LONGEST?	**WEIGHT** 4. WHICH ONE IS HEAVIEST?
LENGTH 5. WHICH ONE IS LONGEST?	**SOUR** 6. WHICH ONE IS THE MOST SOUR?
VOLUME 7. WHICH ONE HAS THE MOST WATER?	**WEIGHT** 8. WHICH ONE IS LIGHTEST?
LIQUID 9. WHICH ONE HAS THE MOST COLORED LIQUID?	**LIQUID** 10. WHICH ONE IS THE SLOWEST?

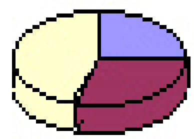
APPLIED SCIENCE - SCIENCE AND MATH (2A)

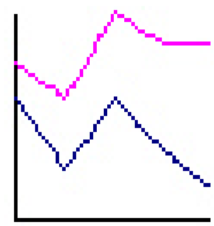
POST LAB

Students graph how much television they watch.

OBJECTIVE:

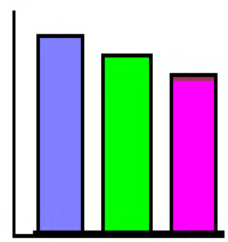
1. Estimating and gathering data.
2. Interpreting results from a data set.





VOCABULARY:

conclusion
guess
hypothesis
prediction
procedure
results



MATERIALS:

worksheet
graph paper

BACKGROUND:

If a subject interests students, they can usually think of many questions they would like answered. The first step in scientific work is to narrow the range of investigation so the question is answered by an experiment showing results in a reasonable period of time. "Why can't Johnny read?" and "Why don't I seem to have time to do everything I want to do?" are not good experimental questions. "How much television do second graders watch LAB the week?" is much better because it is a measurable quantity. The scientific method can be broken down into 3 steps.

(1) Guess what is going to happen;
(2) test your guess; and
(3) record your results.

Do your results match your guess? If not, why not? Real scientists often learn more when experiments do not turn out as expected. They make a new guess and test it. It is important to remind students that there is no one perfect answer. A hypothesis is only a best guess. This guessing, testing and retesting is the most important thing for children to learn when proposing a science project.

PROCEDURE:

1. Explain to students that over the next week they will become scientists testing the question, "How much television do second graders watch LAB the week?" Before scientists can answer a question they must first guess what they think will be the outcome. This guess is called a hypothesis. Ask students to decide how many hours of television they usually watch from Monday through Thursday. You will get all sorts of numbers. Pick one in the middle and see if the class agrees by taking a vote. State their hypothesis formally: "The children in our class watch about X hours of television from Monday through Thursday."

2. Inform the students that a scientist must now test their hypothesis (guess). For this experiment a survey is sent home on Monday with each child. Each student writes down how many hours of television he or she watches on Monday, Tuesday, Wednesday, and Thursday. The surveys should be returned on Friday. Ask the children to use whole hours or half hours. If they only watch a fraction of a program ask them to round the time to the nearest half or whole hour. They can ask their parents to help them with this. If you send home a weekly letter to parents you may want to include this lab into the letter. In this way the parents can remind the children to write in their times accurately.

3. Reinforce the following points before they start the survey. The time must be accurately recorded and there must be a number for each day. The children should follow their normal viewing habits as much as possible. The idea is to get a real picture of how they spend their time, not to see if they can fudge the data to come closer to the time they guessed. Real scientist do not "fudge" data.

4. On Friday, each survey sheet should be checked to ensure that there are entries for all four days. The total will change if a child forgets to write the hours down one day. If there are blanks but the child thinks he/she can remember what programs were watched, fill in the data where missing.

5. Model for the children how to add up the total number of hours watched LAB the four days.

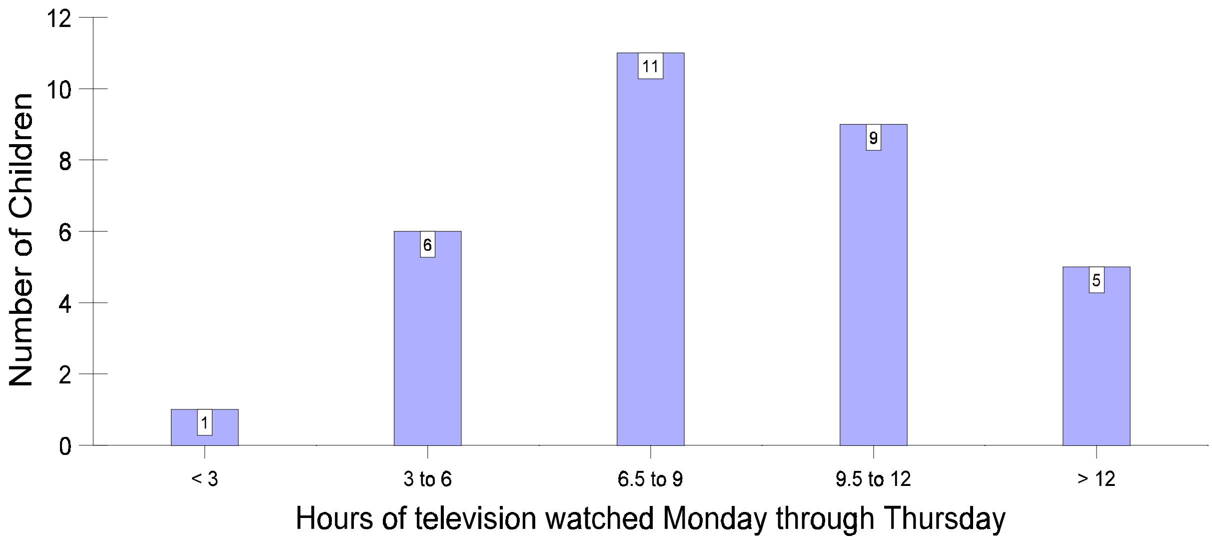
6. Allow them time to add their own numbers. Ask them to have the student next to them check their work.

7. Ask the children to decide into which of the following categories their hours fit. List the categories on the board: 0 to 3 hour, 3 ½ to 6 hours, 6 ½ to 9 hours, 9 ½ to 12 hours.

8. Total the number of children in each category and make a bar graph.

9. Report the range of results (the lowest number of hours watched and the highest number of hours watched). Look at the graph and determine the most common number of hours watched.

10. Look at the children's estimate again. Discuss how their estimate compares with the results?



Example of how the bar graph should look like after you get all the data from the children's data sheets.

11. You may want to summarize the results and include them in a parent letter. Most parents don't realize how much television their children watch. You may want to include alternate activities like reading a book or taking a nature walk to help parents spend more time with their children.

APPLIED SCIENCE - SCIENCE AND MATH (2A) POST

CLASS SCIENCE PROJECT SURVEY

Dear Parents,

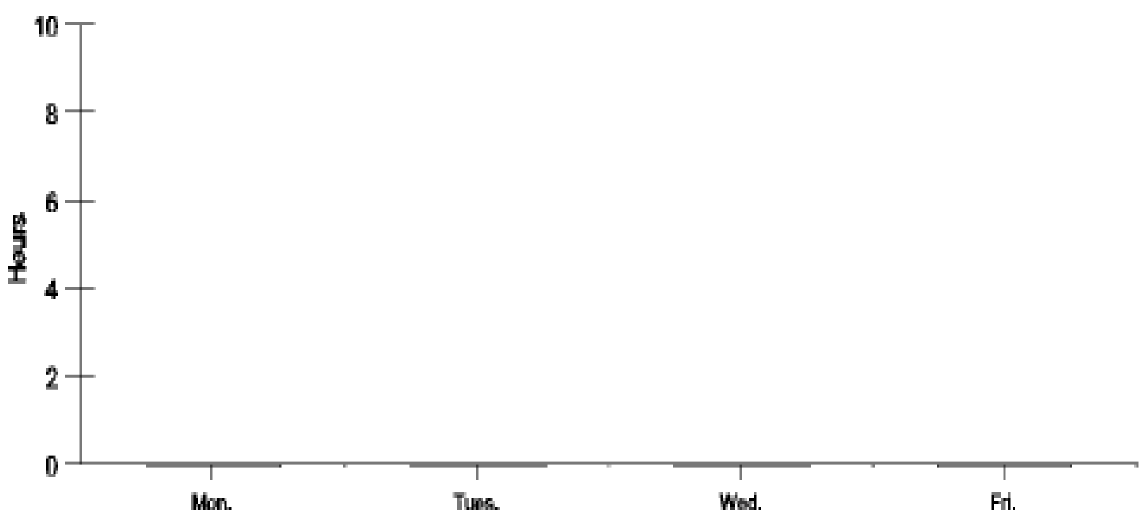
We are conducting a scientific survey to determine the number of hours of television a second grader watches LAB the school week. Please help me keep track of my hours on this worksheet. Remind me to bring this completed survey back to school on Friday.

DATE BEGUN __________________ DATE ENDED ______________________

Write down how many hours of television you watch at different times of the day. Please use half hour increments.

	MORNING	AFTERNOON	AFTER DINNER	TOTAL HOURS FOR DAY
MONDAY				
TUESDAY				
WEDNESDAY				
THURSDAY				
TOTAL HOURS FOR 4 DAYS				

MAKE A BAR GRAPH OF THE RESULTS



APPLIED SCIENCE - SCIENCE AND MATH (2B)

Students learn to draw 3 dimensional objects.

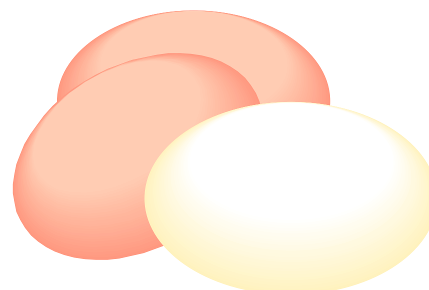
PRE LAB

OBJECTIVE:

1. Comparing and contrasting two and three dimensional objects.
2. Exploring the difference between two and three dimensions.

VOCABULARY:

box
circle
cube
pyramid
rectangle
sphere
square
triangle



MATERIALS:

worksheet

BACKGROUND:

Children are born with the ability to see in three dimensions. From the first building blocks to their first rattler, they touch 3 dimensional objects. However, as children begin school, the world of pencil and paper in a two dimensional world, tend to dominate their learning. The impact is clear, students begin to lose that innate ability to visualize three dimensionally.

Children must learn early, how to describe 3 dimensional objects. They must possess a vocabulary of geometric terms and relationships to accomplish this task. Geometry is a mathematical representation of the real world. Although geometry is perfect, the nature it represents is not. Sometimes it is difficult for children to see the relationship between geometry and nature.

A two-dimensional object is usually a representation of a three dimensional object. Even a flat piece of paper has depth! Common representations include:

A circle is a two-dimensional sphere.
A square is a two-dimensional cube.
A triangle is a two-dimensional pyramid.

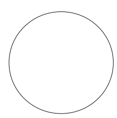
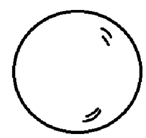
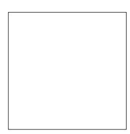
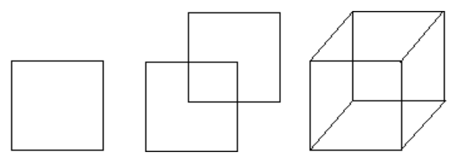
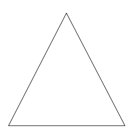
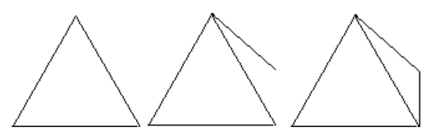
PROCEDURE:

Scientists and mathematicians many time express their ideas on paper as sketches. This activity helps students to draw three dimensional objects.

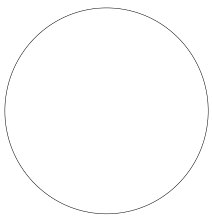
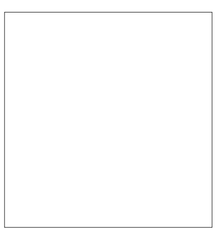
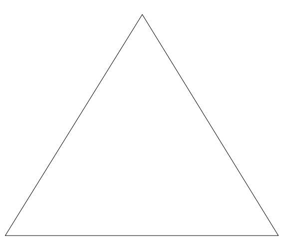
1. Show students a sphere, a cube, and a pyramid. Discuss the differences and similarities between each. For example a sphere has no sharp points or flat surfaces, both the cube and the pyramid do. The cube has six sides; a pyramid can have four or five sides depending on what type of pyramid you have.

2. Illustrate how a circle, square, and triangle can be made to look "three dimensional" on paper. Showing the progressive steps in the drawing process of each object, helps the students to follow along and understand.

3. Allow the students to practice on scratch paper or on the board. This may take a little time, but the students will be drawing these object for years to come.

CIRCLE 	SPHERE 
SQUARE 	CUBE 
TRIANGLE 	PYRAMID 

What is the difference between 2 dimensional and 3 dimensional?

DRAW THE 3D SHAPE AND NAME IT	
 CIRCLE	
 SQUARE	
 TRIANGLE	

APPLIED SCIENCE - SCIENCE AND MATH (2B)

LAB

Students make three dimensional objects from cookie cutters.

OBJECTIVE:

1. Recognizing and comparing shapes.
2. Modeling different shapes.

VOCABULARY:

depth
shape
three dimensional
two dimensional

MATERIALS:

Science and Math (2B) or cookie cutters
clay or play dough (recipe below)
rolling pins (optional)
deck of American playing cards (optional)

BACKGROUND:

Shapes are all around us. Some shapes are used to identify, such as traffic signs. Many people take shapes for granted, not realizing the historical significance that many have. Students should be familiar with a deck of cards. Show them a deck of cards. Ask them what shapes are represented by American playing cards. Hopefully they will tell you spade, heart, diamond, and clubs. Ask them if they know where these symbols came from. Do they think it was a 3 dimensional object or a 2 dimensional object? (Actually these terms refer to both the 3d and 2d version).

These shapes have a historical development. The English liked the French symbols and came up with names to describe them. The original shapes are from heart = biological heart; diamond = mineral; and spade = a tool that farmers used. The club is more difficult to explain; and this is probably why it is the hardest shape to "remember". The club came from the English version of a "trefle" or three foil from the French. The English card-makers thought it looked like a "club."

Children can have difficulty visualizing the original three-dimensional shape after it has been made into a 2 dimensional one . Cookie cutters are a great example. Children sometimes believe that by making cookie dough thick and then cutting their shape out, they are creating a 3 dimensional shape. They often forget the features which were compressed in order to make it 2 dimensions, like a nose, mouth, or muscles!

PROCEDURE:

Emphasize that shapes are all around us. Some we can model easily, but others are difficult. Tell students many people, even teachers, use 2 dimensional items for something that is 3-dimensional. Students will have to think before they name a shape. The difference between 2 dimensional and 3 dimensional is that 3d has depth or as it is commonly referred to, the "third dimension." The other two are length and width.

1. Instruct students they will be turning a cook cutter shape into a 3 dimensional object. Make sure clues are give on how to turn a 2 dimensional cookie into a 3 dimensional object. However, do not show them an example, because the key is for the children to discover for themselves how "flat" or two dimensional they really see the world.

2. Give students a piece of wax paper to do their activity on. Provide enough clay or play dough so they can roll it out as "dough." If you have rolling pins you may want the students to roll it out. You can prevent a mess by first putting another piece of wax paper over the clay and then rolling it. If you don't have rolling pins the students can flatten the clay by pounding on it with their hands.

3. Each person in the group should make a cookie cutter shape. Direct them to construct a three dimensional model of the cookie cutter shape. For instance, a circle should turn into a sphere, but you can also consider a cylinder correct. If you have a "gingerbread" type cutter, students should include a nose, mouth and other three dimensional characteristics of a person. Again children can have a difficult time understanding three-dimensional objects.. They believe that thickness is enough. Guide them to understand this concept and they will remember it their entire life.

RECIPE FOR PLAY DOUGH

MATERIALS:

250 ml flour
125 ml salt
5 ml cream of tartar
250 ml water
about 1 ml food coloring
about 1 ml oil

DIRECTIONS:

Cook, with stirring, over medium heat until the gloppy mess looks like play dough. Knead briefly after the mixture has cooled a little. You will need to multiply this recipe by 6 to get enough for a class of 30 students, but it should be made in two batches. Large amounts of dough are difficult to stir because the mixture becomes firm. Store the play dough in a plastic bag or margarine tub.

Play dough can be made and saved for a long time if it doesn't dry out. Color the various play dough mixtures depending on the activity. Many activities do not require a specific color.

APPLIED SCIENCE - SCIENCE AND MATH (2B)

PROBLEM: Can you make three dimensional shapes from two dimensional shapes?

PREDICTION: ____

TRACE YOUR COOKIE CUTTERS. NAME THE SHAPES YOU ARE USING.

Roll out the playdough. Cut out shapes using cookie cutters. These are two-dimensional shapes. Show your teacher. After your teacher has seen the shapes, make a three-dimensional model of the shapes and draw what they look like. Have your teacher see your final shape.

CONCLUSION: What is the difference between two dimensional and three dimensional shapes?

____

____

APPLIED SCIENCE - SCIENCE AND MATH (2B)

POST LAB

Students create patterns using unit cells.

OBJECTIVES:

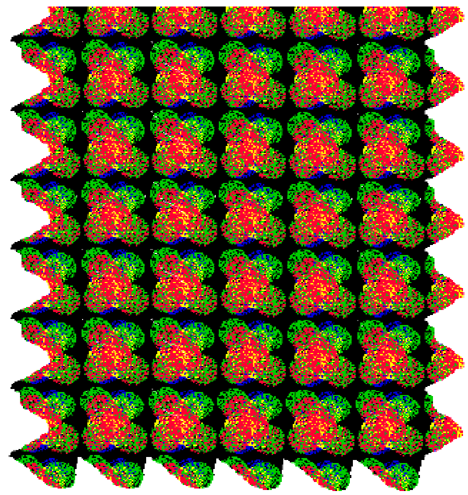
1. Recognizing patterns.
2. Exploring unit cells to create patterns

VOCABULARY:

geometry
pattern
symmetry

MATERIALS:

crayons
pattern blocks
worksheets



What is the pattern in this picture?

BACKGROUND:`

Geometry is the branch of mathematics dealing with the properties and relations of lines, angles, surfaces and solids. All objects, whether the smallest protozoa to the largest building in the world, can be described through geometric descriptions. Symmetry is the ability to divide an object into parts, equal in size and shape and similar in position on either side of a dividing line or around a center. A pattern is an arrangement of shapes or colors in a design with a repeatable quality.

In order for students to understand the difference of these terms, they must practice and train their mind to observe and pick out patterns and symmetry.

A pattern usually has a "unit cell" that repeats itself. Even if one tree (unit cell) repeats itself in a row, it is a pattern. A row of pegs can be a row of trees. Patterns are all around us. A diamond shape is actually 4 points (unit cells). If you combine several diamond shapes, you get an overall pattern different from the original diamond.

The unit cell in the picture above is a 4 “rounded cornered rose.” The overall pattern is “rectangular.” However, because the corners are not real rectangles the description is difficult.

PROCEDURE:

This set of two activities, guides students into defining a unit cell, which is very important in determining a pattern. The repeatability of the unit cell, including the same color and shape, is important to recognize. The more experience a child has with identifying the unit cells the easier it becomes.

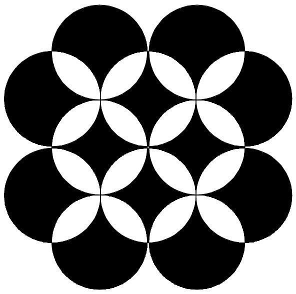
1. Give each student a worksheet and crayons. Instruct them to color or outline the unit cell on the worksheet. (Answers: 1. circle; 2. square; 3. triangle; 4. circle; 5. square; and 6. circle.)

After they complete that see if they can create a pattern with any unit cell they decide on. Notice that we don't write in the colors for the unit cell, let them decide if color helps determine the unit cell (it does!). This will give students practice on keeping the unit cell the same.

2. When students complete the worksheet give them one box of pattern blocks per group. Instruct students to work together to create a pattern with one or more unit cells. Let their creativity go. Group cooperation is important.

APPLIED SCIENCE - SCIENCE AND MATH (2B) POST

WHAT IS A UNIT CELL?



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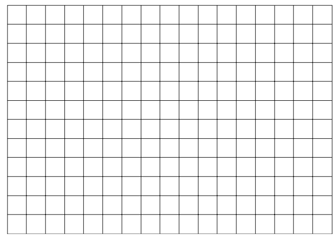

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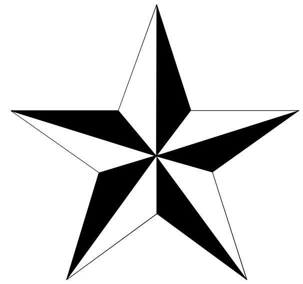

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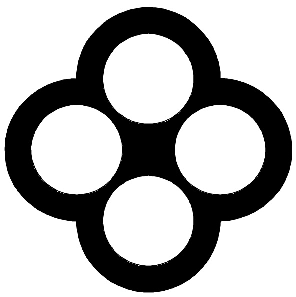

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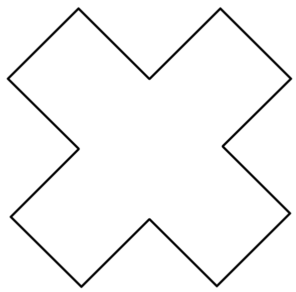

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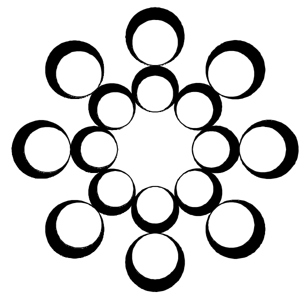

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CREATE A PATTERN WITH ANY UNIT CELL

APPLIED SCIENCE - SCIENCE AND MATH (2C)

Students classify different objects into their symmetry.

PRE LAB

OBJECTIVES:

1. Investigating symmetry.
2. Comparing symmetry of geometric shapes.

VOCABULARY:

bilateral
cubic
hexagonal
pattern
pentagonal
radial
symmetry

MATERIALS:

Googolplex

BACKGROUND:

Symmetry refers to, "the correspondence in size, form, and arrangement of parts on opposite sides of a plane, line, or point." If you look at the word in the dictionary, you will notice a list of definitions for subjects as diverse as geometry, botany, physiology, chemistry, and geology. Symmetry can refer to two dimensional ans well as three dimensional objects. Some objects can have one or more symmetries. In nature symmetry is not always perfect, but the terms are still applicable.

Bilateral symmetry is when one side looks like the other or is a mirror imagine. Humans are bilaterally symmetrical . If you make an imaginary line from the head to the ground; one side basically looks like the other. However if you look at the organs inside a human, they are not bilaterally arranged.

Radial symmetry is when all segments are equal that radiate from a point. A ball or a circle has radial symmetry. Note that all objects that have radial symmetry also have bilateral symmetry.

Pentagonal symmetry reflects a five-part symmetry. The echinoderms (sea stars, sand dollars) are an excellent example of pentagonal symmetry. This is easily recognized as a “star” shape. Internally, echinoderms also have a five part symmetry.

There are other ways of dissecting symmetry including hexagonal symmetry (six-part) and cubic symmetry (three-dimensional square). Symmetry is all around us if we just look and describe.

PROCEDURE:

1. The objectives of this week's activities are to illustrate the difference between symmetry and patterns, especially in nature. The first exposure to these concepts will give students a new vocabulary power to describe and observe the world. Go over each of the above vocabulary words and illustrate with examples. Reinforce the types of symmetry so children can learn by experience. Listed below are a few ideas.

2. Use the **Googolplex** to illustrate the different types of symmetry. Include bilateral, radial, pentagonal, hexagonal, and cubic. Construct these examples (using the book as a guide) before class or have students follow the patterns in the worksheet. Draw the different types of symmetry on the board and have students think of examples. They might also try to construct their own geometric shapes. Reinforce the words using a model and do not expect students to learn with just one introduction.

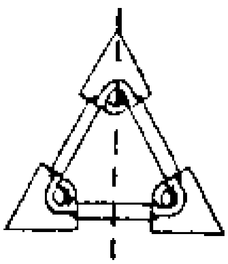
3. Students will continually use these terms throughout this program. This is only an introduction to symmetry. Start them off right!

The worksheet will help illustrate different types of symmetry using models. Look at your worksheet and record the appropriate symmetry.

1. bilateral symmetry = one side looks like other
2. radial symmetry = radiate from a point
3. pentagonal symmetry = 5 part symmetry
4. hexagonal symmetry = 6 part symmetry
5. cubic symmetry = 4 part symmetry

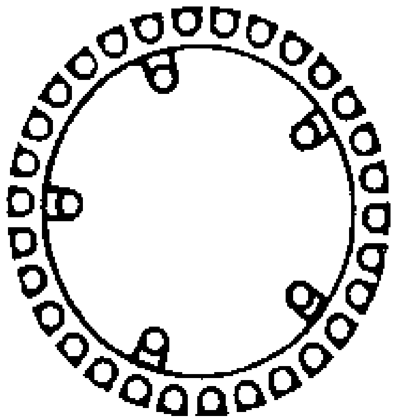
bilateral

one side looks like other



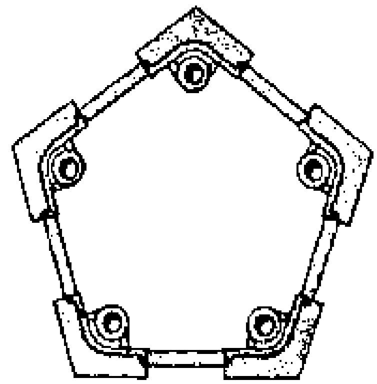
triangle frame

radial



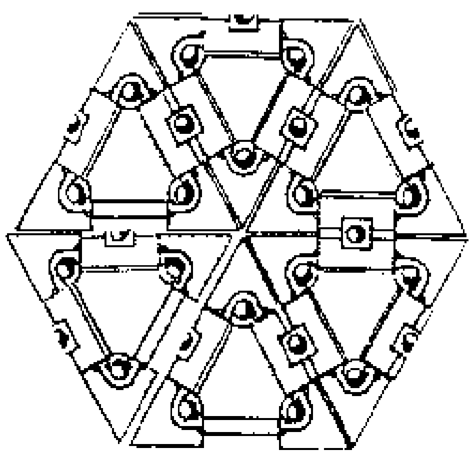
points radiate from center
wheel frame

pentagonal

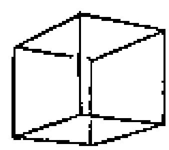


5 part
pentagonal frame

hexagonal

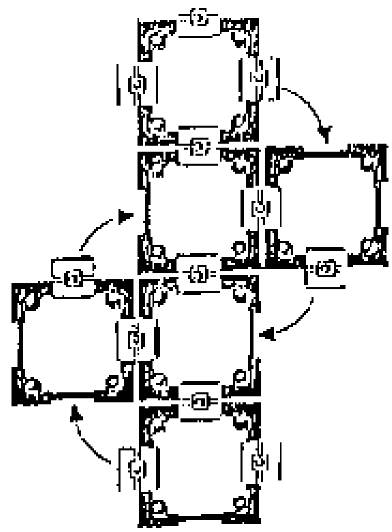


6 part
six triangle frames



cubic

6 square frames



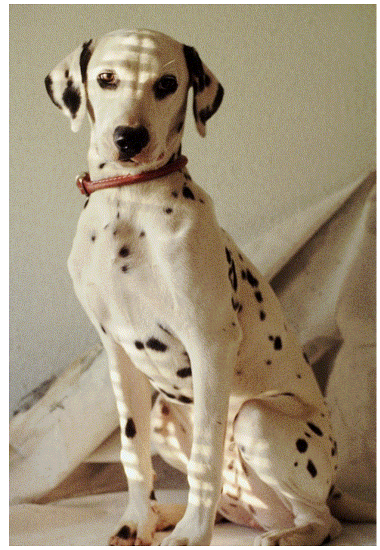
APPLIED SCIENCE - SCIENCE AND MATH (2C)

Students look at symmetry in nature.

LAB

OBJECTIVES:

1. Comparing symmetry nature.
2. Describing organisms.



VOCABULARY:

patterns
symmetry

MATERIALS:

Science and Math (2C) or appropriate materials
Magnifier Kit

BACKGROUND:

Symmetry and patterns are sometimes difficult to determine in nature. Unit cells of patterns are not as well defined as in pattern blocks. Symmetry can be considered as an "overall" descriptive term. Humans and most vertebrates are bilaterally symmetrical. All echinoderms have a 5 part pentagonal symmetry

It is important to look at the overall symmetry first and then to describe the patterns that might be on organisms. Organisms sometimes have different patterns on different parts of their body. The picture of the Dalmatian above is bilaterally symmetrical and there is no pattern of the "dots."

PROCEDURE:

1. Review patterns and symmetry. Patterns are repeated; symmetry refers to the overall design.

2. In this lab, students will try to discover different symmetries by observing different organisms.

At each of the 10 stations, students observe the materials and first decide if the specimen has a particular symmetry. Then see if they can detect a pattern. Sometimes an object may not have a symmetry and sometimes it doesn't have a pattern. Let students determine for themselves.

3. If you are using the kit, the following are the appropriate answers.

1. *Bubbles:* Students should blow just once through the bubble-maker. Make sure this is clearly explained or you will have bubbles all over the room. Bubbles have radial symmetry. There is no pattern.

2. *Sea cookie, sand dollar, and sea star:* Have students look closely. Have students observe the pattern with a hand lens. All of these organisms have pentagonal symmetry (5 part). The pattern is of very fine holes throughout the skeleton of the organisms.

3. *Glass sponge:* The sponge is very delicate and students should observe only. This sponge is made up of silica dioxide (same ingredients as glass). The sponge has bilateral symmetry and has groups of four patterns.

4. *Snail shells:* These marine snails do not have any symmetry, but it has a coiled or spiral pattern. This observation might be hard for students, but noticing the spiral pattern is important. The pattern is different than a whorl which is coiled on the same plane; a spiral is off centered like a staircase.

5. *Pyrite:* This mineral has a "cubic" symmetry. The symmetry can not be determined easily, because it is not continuous. This is difficult to see unless you have a very good specimen.

6. *Leaf:* Collect a few leaves from outside. If your classroom has a live plant, it may also be used. Have students look at the veins in the leaves. Many have bilateral symmetry as well as a pattern of veins (dendritic).

7. *Coral:* Many corals do not have symmetry because they grow in whatever shape they want. The coral you have is not symmetrical, however, it has a pattern of pores all over the skeleton. If you look at the individual pores they have a radial symmetry (may need hand lens or microscope).

8. *Quartz:* Has a hexagonal symmetry if the crystal is complete. There is no pattern.

9. *Bivalves* (clams): Please note that this is an entire bivalve and it has bilateral symmetry. The pattern reflects ridges and spines.

10. *Slice of Tree:* Notice that it has not perfect radial symmetry. The rings make up its pattern.

APPLIED SCIENCE - SCIENCE AND MATH (2C)

PROBLEM: Do different organisms have different symmetries and patterns?

PREDICTION: ______________________________

ITEM	SYMMETRY	PATTERN
1.		
2.		
3.		
4.		
5.		
6.		
7.		
8.		
9.		
10.		

CONCLUSION: Are the patterns and symmetry of different organisms similar? Explain.

____

____

APPLIED SCIENCE - SCIENCE AND MATH (2C)

Students create tessellations.

POST LAB

OBJECTIVES:

1. Comparing symmetry and patterns.
2. Discovering tessellations.

VOCABULARY:

geometry
pattern
polygon
symmetry
tessellations

MATERIALS:

Googolplex
worksheet

BACKGROUND:

Tessellations are an assemblage of regular polygons that do not overlap. The word "tessellate" is derived from a Greek derivation which refers to the four corners of the tiles in a mosaic. There is different levels of understanding tessellations. In elementary school it is important to understand what a "polygon" refers to.

A tessellation can be considered a pattern of polygons. The limits of a tessellation are that the polygons are regular. The object of this exercise is to see how many different tessellations students can discover. A pattern is not limited to just polygons. So, a tessellation is a specialized pattern.

PROCEDURE:

1. Before the students begin this lab, explain the geometric world of tessellations. Now that the students have an understanding of patterns and symmetry, have the students go home and find these patterns. If possible, make this an ongoing project. What you are doing is giving the students the "power" to observe. This type of project will also allow you to discover which students have an "artistic" eye.

2. Have students do the worksheet before they use the building set. This will help students think of a design before they actually do the activity. Students will soon realize that there are constraints to geometry. You just can't put a triangle against a pentagon

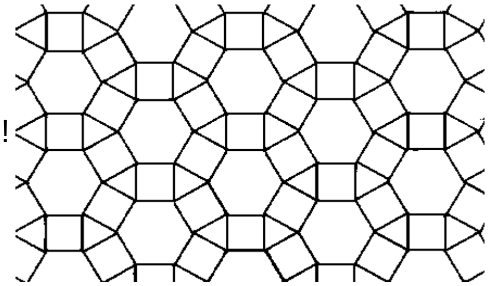
without constraints on the overall design.

3. Students should each have a building set of Googolplex. Ask them to make a flat pattern. Use the connectors to join the triangles, pentagons, and squares. Remind them that a pattern is repeatable. They should think of a design before they complete the project.

Go over the symmetry of each of the pieces. The triangle has a three-part symmetry, the pentagon has a five part symmetry, and the square has a four part symmetry. Use the term "tessellation" to refer to the geometric mosaic that the students are creating. Remember if they are using a circle in their pattern, it is not a tessellation.

APPLIED SCIENCE - SCIENCE AND MATH (2C)

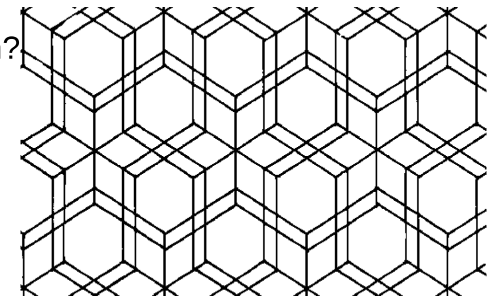
TESSELLATIONS



Think Design!

A.

1. How many different shapes are used in this design!
2. Outline the unit cell.



B.

1. How many different shapes are used in this design?
2. Outline the unit cell.

Next, see if it works using GOOGOLPLEX. You can only use triangles, squares, and pentagons. Draw your tessellation below.

CREATE A TESSELLATION