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ABSTRACT

Many times science does not provide us with exact descriptions of phenomena or answers to questions but only allows us to make educated guesses. Black box activities encourage this method of scientific thinking because the activity is performed inside a sealed container requiring the students to hypothesize on the contents and operation of the activity. This collection of hands-on activities was developed by inservice teachers employed by the Department of Defense Dependents Schools Pacific Region and were designed to help students achieve these realizations. The activities included are as follows: (1) "The Mystery Box"; (2) "A Black Box"; (3) "Black Box Activity a Project in Inferring"; (4) Black Box Creating Your Own Constellations"; (5) "Black Box Shadows"; (6) Black Box Activity Electrical Circuits"; (7) "Black Box Grades 6-9"; (7) "Ways of Knowing-Activity 2 The Black Box"; (8) "Black Box Experiment"; (9) "The Hands Down Method of Random Sampling of Icebergs for Polar Bears and Ice Holes. A Black Box Activity"; (10) "Black Box Materials Identification"; and (11) "Milk Carton Madness." Each activity contains an overview, purpose, objectives, procedures, brief discussion of the results obtained in the classroom, and additional suggestions for classroom use. (ZWH)

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BLACK BOX ACTIVITIES FOR

GRADES SEVEN - NINE SCIENCE PROGRAMS AND BEYOND

A SUPPLEMENT FOR SCIENCE
1, 2, & 3

Department of Defense Dependents Schools
Pacific Region

INTRODUCTION

Black Box Activities for Grades Seven - Nine Science Programs and Beyond is a collection of activities developed by inservice teachers employed by the Department of Defense Dependents Schools Pacific Region who took part in a science program inservice held at Kadena Air Base Okinawa, Japan during September 1993. The inservice progran was designed and conducted by Manert Kennedy and James Hubbard of the Colorado Alliance for Science, University of Colorado, Boulder, CO 80309 with funding from the Department of Defense. The activities are intended to supplement the Science Interactions Course 1, ISBN 0-02-826032-5, 1993, Science Interactions Course 2, ISBN 0-02-826098-8, 1993, and Science Interactions Course 3, ISBN 0-02-826107-0, 1993 hands-on science programs published by Glenco .

All activities included in this publication are in the unedited form. Credits for the activities are provided at the beginning of each activity.

As we are aware, science is a process by which people attempt to describe the universe in which they live. In many cases the descriptions provided by the evidence available allows only tentative descriptions, open ended at best. We accept those descriptions only for the present, agreeing that we are willing to change them once additional evidence indicates a need for modification. The activities included herein are intended to help students come to the realization that science many times does not provide us with exact descriptions of phenomena or answers to questions but only allows to make educated guesses.

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CONTENTS

THE MYSTERY BOX

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THE MYSTERY BOX

Mysteries have challenged the best minds among archaeologists, anthropologists, alchemists, climatologists, linguists, and historians since the beginning of time. Going back to the time when men saw a wooden nymph in every tree and magnificent figures among the stars, to the time when they looked for a UFO on every clear night, mysteries have held their grip on human imagination. Mysteries and curiosities have held their grip on human imagination and have probably contributed to the accomplishments of many great scientists. The best description of mystery was given by Albert Einstein over 60 years ago. He stated that the most beautiful thing that can be experienced is the mysterious; it is the source of all true art and science. Those who are strangers to this emotion, who can no longer pause to wonder and stand rapt in awe, is as good as dead; their eyes are closed.

Since people have such great appetites for mystery, why not take advantage of the opportunity to attract the interest of students.

Purpose

During this activity, students will;

1. Use the appropriate senses to observe the mystery box.
2. Develop mental models based on their observations.
3. Discuss the structure and appreance of the interior of the box.
4. Diagram their idea of how the box look inside and give a written description of the interior of the box.

Materials

1 large box(30"x30"x30")
Duct tape and masking tape
Styrofoam pieces
Plastic heads of black cats(2)
Medium size plastic human skulls(2)
Stiff cleaning brushes(2)
Rubber water hose(3 meters)
Small wooden chair from doll house
Troll doll
Nerf balls(2)
Large fuzzie spider
Large sleeve(18 inches long)
Cans of spray paint(black and red)

The materials above can be arranged as desired and secured with duct tape or masking tape.

Procedures

1. Place the mystery box on display so that all students can see it as they enter the room. Give no explanation, or answer any questions for at least one day. Allow the imaginations of the students to run wild for at least one day.

2. Form teams of 4, two observers and two designers. Ask each team for suggestions as to how they can determine the structure of the interior of the box.

3. Rules:
   a. Each observer will be allowed to examine the interior of the box with one hand. There will be a time limit of 30 seconds.

   b. No one is allowed to peak in the opening of the box. This opening must remain covered at all times. If any observer attempt to look inside, the team will be disqualified.

4. After examining the inside of the box, the designers will draw the inside based on the descriptions given by the team's observers. Teams must also give a written description of the interior of the box.

5. Display the descriptions and designs of each team and allow them to ask and answer questions.

Results And Conclusions

The box was prepared and all items were held in place by the masking and duct tape. An opening was cut in the side of the box. This openine was large enough for a person to place an arm inside without any difficulty. The opening was covered with a sleeve shaped piece of black fabric. The sleve was covered with a card board flap that could easily be lifted.

The box was displayed for 2 days and students' curiosities were running wild. After the second day the activity was carried out. All students were excited about the activity and wanted to be the one to examine the inside.

Thsi activity was exciting, interesting and fun. It encouraged students to work together as a team and required them to rely on their sense of touch to develop a diagram of the mystery box.

The box remains closed and students are still wondering about the contents. They have been informed that most of them had the right idea. They were all encougaged to design and build their own mystery box.

Suggestion For Additional Models

A mystery box could be developed for K-3 grades. To do this, a large crawl through box would be needed. This box should be a very large one from large appliances. There should be an opening on both ends. Each opening should be covered by a dark curtain so that light cannot get in. An alternative would be to make a tunnel leading into the box. The box should be dark inside. A variety of large stuffed animals and other soft fuzzy creatures and items should be placed in varicus locations inside the box. One student at a time should be allowed to crawl through to examine the inside with their hands. A time limit of one minute should be allowed for each student. When all members of a team have explered the dark interior of the mystery box, they should work together to give a description of the inside. Students can give verbal descriptions, written descriptions, or make a diagram.

A BLACK BOX

BY

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SCIENCE ACTIVITY

A Black Box

PURPOSE

IN THE BLACK BOX ACTIVITY THE STUDENTS WILL

* MAKE MULTISENSORY OBSERVATIONS OF BLACK BOXES.
* DEVELOP CONCEPTUAL MODELS OF BLACK BOXES.
* COMMUNICATE MODELS THROUGH DISCUSSION AND DRAWING.
* CONSTRUCT CONCRETE MODELS TO COMPARE TO CONCEPTUAL MODELS.
* LEARN CONCEPTS THAT WILL CONTRIBUTE TO UNDERSTANDING OF THE FOLLOWING THEMES:

STRUCTURE

INTERACTION

and

SYSTEM

SCIENCE CONCEPTS:

BLACK BOX MODEL

SCIENCE THINKING PROCESSES:

* OBSERVING
* COMMUNICATING
* COMPARING
* ORGANIZING
* RELATING

INTERDISCIPLINARY ACTIVITY:

* LANGUAGE

OVERVIEW

All the boxes you and your classmates will use in this experiment are the same. The first step is to find out as much as you can about these boxes without pulling the rods out of the boxes and with out opening them. Look at one of them, shake it lightly, tilt it back and forth in various directions, and listen carefully to the sounds. you will find it very useful to write down your observations. This will help you to compare notes with your classmates so that you can arrive at a model, make predictions, and test them.

The class is presented with a set of two boxes labeled A. and B. with three rods extending out two running horizontal and one running vertical. Students work in two groups to determine what is inside. After 15 minutes, a student from each group draws a picture on the board (mode hat explains what the pair thinks the inside of their box looks like. After further investigation and discussion by the class a spokesperson for each group draws the consensus model for what the group thinks the box looks like inside. The activity concludes with a discussion of models, sensory information, and the method for improving the models.

DOING THE ACTIVITY

Part 1: Black Box Investigations:

1. **Introduce the Black Box**

Challenge. Holdup a black box. Shake it gently and tell the students that there is something inside, but you don't know what, and you can't look because the box can't be opened. Remind students to be vary careful when handle boxes because of the wooden pointed rods sticking out. Their challenge will be to figure out **what the box looks like inside and what might be attached to the rods.**

2. **Form Teams of Four**: Have the students work in pairs of two. One student will be the **STARTED** the other, the **RECORDER**. Each team will investigate one box. Instruct the students to take turns with the box so everyone has a chance to participate in the investigation.

3. **Give the Rules:** To prevent damage to the boxes, explain the rules of investigation to the students.

* The boxes remain closed (unless instructed by the teacher to see what would happen if you removed one of the rods from the box).

* No drawing on the boxes.

* No violent shaking or hard pressing----boxes can break along with rods.

Assign Boxes: Have one person from each group appointed to pick up boxes labeled A and B.

Have the **STARTERS** go to the materials station to get a box with their assigned letter. Let the teams start to figure out what the box looks like inside and what might if anything attached to the rods. Tell students that after you have done all the experiments you can think of. *(with out pulling out the rods)* try to imagine in a general way what is inside the box that could account for their observations. This will be the model for the box. Do not be distracted by details. Do not, for example, try to name the objects inside the box; only describe them by the properties that you have found in your other experiments. If you hear something sliding on one of the rods; you could easily describe it as a washer or a ring or lead weight for a fishing line; but the important point is that it is something with a hole in it through which the rod passes.

Tell students that after you have made models that account for your observations, predict what will happen as you pull out a particular rod. Also predict how this will affect the results of the tests you performed earlier. Then you or one of your group members can remove a rod from only one of the boxes. Pulling out one of the rods may change things enough to prevent your checking your prediction of what would have happened had you pulled out another rod first. If what happens confirms you predictions, you can use one of the other boxes to test your predictions about what would happened if you had pulled out one of the other rods first.

5. **Identify the Marble:** After two or three minutes, ask the students what they have discovered. When someone suggests that there is a marble in the box (or may be a washer or a ring or even a lead fishing weight). Ask for a show hands from those who agree. Confirm that each box has a marble.

Encourage the students to concentrate on the LOCATIONS and SHAPES of things in the boxes. Suggest to the students that drawing pictures or diagrams might help them figure out what's inside the boxes.

6. **Explain Drawing Box Contents.** After the students have been working 10 to 15 minutes, call for attention and explain that the RECORDER from each group will come to the board and draw what their box looks like inside.

7. **Introduce Model.** When drawings are on the board, tell the students that the pictures they have drawn are MODELS of Black Boxes.

Explain to the class that people make MODELS of things that are very big, like the solar system, things that are very small, like atoms, and things that are impossible to into, like black boxes. *a MODEL is a REPRESENTATION OR EXPLANATION OF something that shows how it looks or works.*

8. **Discuss the making of the Models.** Ask the students what senses they used to explore the boxes. Ask them to demonstrate the techniques they used to investigate the boxes.

9. **Work Toward Consensus.** Tell the students that *CONSENSUS MEANS EVERYONE AGREES.* The groups should try to reach consensus on the best model for their boxes through discussion, observation, testing of ideas, and carefully applied techniques. Then have a Recorder form each group come up to the board and draw the consensus model on the board.

10. Discuss the Final Models. The students may want to open the boxes. Explain to them.

> *There are many things in world like **BLACK BOXES** that can't be opened-the center of the earth, atoms, the sun, etc. We try to understand what they look like and how they work by getting as much information as we can. When we get new information, we change our models to include the new knowledge. Models always represent our best explanation of how things look or work, and models can always change.*

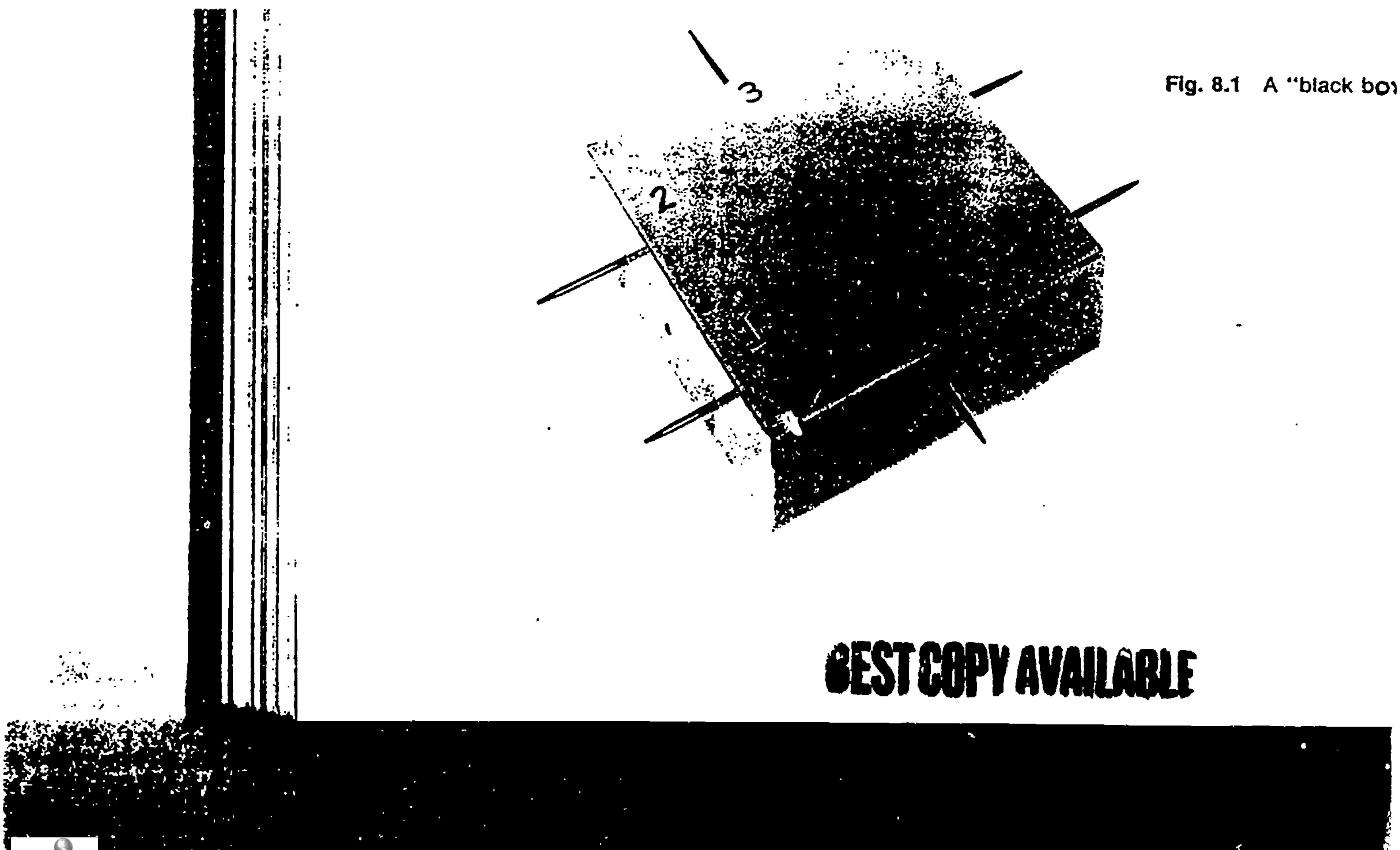

Fig. 8.1 A "black bo

BLACK BOX ACTIVITY
A PROJECT IN INFERRING

BY

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BACKGROUND FOR TEACHER

In science we often seek answers for which we can not really "know" when we have the right answers. Just as we can not explore the interior of the earth, we build our knowledge of what's inside by the collecting of data that allows us to draw conclusions of what probably constitutes the interior. By measuring seismic waves from an earthquake's released energy that had been stored, we can compare the two types of waves. P-waves are compressional waves. As P-waves travel through matter, the matter is alternately compressed and expanded much as sound waves travel through air. By using a Slinky (registered trademark) stretched to 10 feet or so along a smooth surface, hold one end in place and push in the other end suddenly then holding it still a compressional wave can be demonstrated. S-waves are shear waves with a side-to-side motion. Using the same Slinky, stretch out as before, this time pull out on the side causing the loops to move sideways related to each other not closer as with the P-waves. The use of seisographs allows us to measure ground motion caused by these waves. P-waves travel faster through rock than do S-waves. We are then able to surmise what the earth's interior is composed of. By using this type of thinking with the collection of data, we can begin to construct the BLACK BOX INTERIORS.

All of Science is a black box. We seldom are able to demonstrate the reality of ideas in a physical manner. We can only infer. This is an activity in inferring.

PURPOSE

In black boxes the students will:

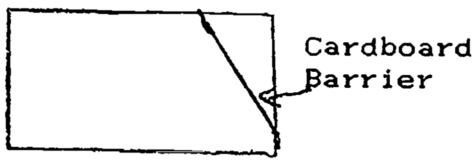
1. investigate and observe a black box
2. predict what the inside of the box looks like
3. gather and organize data
4. draw conclusions

OVERVIEW

In this activity students play with black boxes to discover what the interior is like based upon the behavior of the object inside the black box and its interaction with the interior. After drawing the physical interior of a black box students will exchange their black box with other groups and draw that black box. This box interchange will continue until each group has had access to and drawn th interior of each of the 6 black boxes. Based upon what they think happens when the box is moved, they are to come to consensus, in their group, as to the shape of the interior of the black box.

GETTING READY

1. Build black boxes. Take 6 boxes, all the same dimensions. Use a marble for each interior. Make a change in each box using cardboard and tape (I am going to try hot glue and cardboard next time) so the marble does not roll true to each corner. Example:



   Cover boxes with black paper.

2. Run off sheets for copying the interior for each group. Run off individual sheets.

FOR EACH GROUP OF 4 STUDENTS

1 - Black box with number on the top

1 - Pencil

1 - Student sheet per black box

1 - Group sheet

FOR THE CLASS

6 - Black boxes

1 - Master of group inference sheet

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VOCABULARY DEVELOPMENT

Inference : Logical conclussions based upon reasoning - decisions based upon observations.

Waves : One of the periodic vibratory impulses produced by a disturbance in and propagated through an elastic medium.

Prediction : An assertion based on data.

REFLECTING ON THE ACTIVITY

1. Were all the boxes the same?

2. What helped you form ideas on what the box looked like inside?

3. Can you think of something else we can't see but use the BLACK BOX method to figure it out? (example - Gravity)

4. What job would require you to make a lot of inferences?

DOING

1. Form groups at each lab station. 4 per group for a total of 6 groups.

2. Introduce the activity by explaining the process of inferring. Do the worksheet from the Focus On Life Science series by the Charles E. Merrill Publishing Co., Columbus, Ohio 1984

3. Distribute boxes and individual sheets and group sheets. Explain each group must come to consensus and submit only 1 drawing per box on the group sheet.

4. Record individual inferences of the boxes interiors and then proceed to work on 1 concept or drawing of the box for the group worksheet.

5. Exchange boxes and repeat #4 until all boxes have been seen by all groups.

6. Compare and graph on an overhead the results of each box. Was consensus reached - How many groups agreed?

7. Clean-up

Please draw what your group agrees is the interior of the box.

Box 1

Box 2

Box 3

Box 4

Box 5

Box 6

Group Sheet

BOX 1	BOX 2	BOX 3	BOX 4	BOX 5	BOX 6

GROUPS IN AGREEMENT

Name ______________________________ Date__________ Class______________

Part B

Sometimes you make decisions that are based on your observations. Such decisions are called inferences. Inferences are logical conclusions based on reasoning.

Look at the diagrams below. Read the statements. Based on what you observe, decide if each statement is an observation or an inference. Write observation or inference on the line to the left of each statement.

FIGURE 2-2

______________ 1. The plant has roots.

______________ 2. The plant uses water.

______________ 3. The plant has leaves.

______________ 4. The plant has flowers.

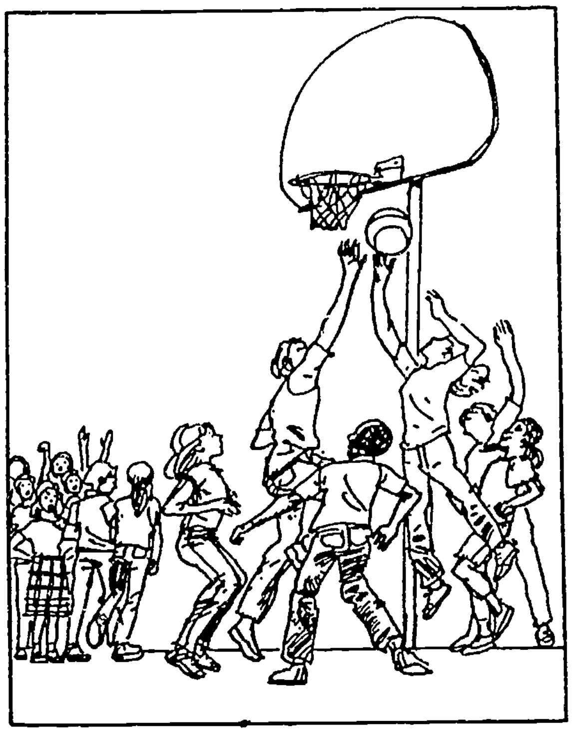
______________ 5. The plant grew from a seed.

______________ 6. The plant is growing in soil.

______________ 7. The plant is green.

______________ 8. The plant is growing in a pot.

FIGURE 2-3



______________ 9. Young people are playing basketball.

______________ 10. The players are in seventh grade.

______________ 11. People are watching the game.

______________ 12. The score is tied.

______________ 13. The game is almost over.

______________ 14. The people are outdoors.

______________ 15. There are six players.

BLACK BOX CREATING YOUR OWN CONSTELLATIONS

BY

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Strand

Scientific Reasoning and observation

Scientific Concepts

Black Box Puzzle

Scientific Thinking and Process

Observe
Communicate
Organizing
Relating

Interdisciplinary Activities

English
Art

Purpose

To show how the constellations came into being

With star dots the students will;

1. Observe dot locations

2. Visualize constellations and create their own constellations.

3. Create myths for constellations.

4. Communicate their stories to the rest of the class

5. Draw a picture with in the framework of the constellations as an art addition to the science class.

6. After presentations students will draw with red pencil the northern constellations over their own constellations. These will be the constellations

normally present in the Northern Hemisphere for the current month. The students will then compare their visualization to the ancient Greek view of the stars and the constellations.

Procedure

Make a map of dots from a star map of the northern hemisphere. Use carbon paper between the star map and the paper. After finishing the marking of the star dots go over the dots with number 2 pencil to insure they will copy easily on the duplicator.

Before the map of dots is passed out, students will learn about the constellations and myths that surround them. Students will also view films on constellations and the universe along with viewing the star chart of the northern constellations.

Students then will be required to draw their own constellations at they see them on the map of dots. Students can look for patterns and draw from one to three constellations. All constellations drawn must be included in the myth.

Students will make presentations to the class on their constellations and myths.

After the presentations students will look up constellations in the Northern Hemisphere and mark them in red on their star maps and then compare their constellations with the real constellations.

Students are graded on their presentations, the constellations, art work and the myth that accompanies their constellations.

Materials Needed for each student

1 set of dotted star charts
1 Red pencil/Pen for drawing in the actual constellations
1 regular pencil
1 text and the included star chart of the Northern Constellations

END

NJS505B.WPS

BLACK BOX SHADOWS

BY

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BLACK BOX
SHADOWS
GRADE 7

SCIENCE CONCEPTS:
LIGHT AND SHADOW

SCIENCE THINKING PROCESS:
OBSERVING AND INFERRING
COMPARING AND CONTRASTING

PURPOSE:
USE THE STUDENTS SENSE OF SIGHT TO OBSERVE AND INFER

OVERVIEW:
STUDENTS WILL BE SHOWN A BALL SUSPENDED FROM A STRING IN FRONT OF A PROJECTOR LIGHT. THE SHADOW WILL BE PROJECTED ON THE SCREEN .

MATERIALS :
PROJECTOR
SMALL FLASH LIGHT
BALLS ON STRING - BASKETBALL, PING -PONG BALL
CUT OUT OF A CLOWN
TWO PIECES OF CARDBOARD 3X3" AND 6X6"
PINS WITH ROUND PLASTIC HEADS. WHITE PAPER WITH A PENCILED CIRCLE 10 INCHES IN DIAMETER IN THE CENTER.

DO AND DISCOVER:
HOW ARE SHADOWS FORMED ?
1. COVER THE LENS OF A PROJECTOR WITH A DISK THAT HAS A SMALL HOLE IN IT . SHINE THE BEAM OF LIGHT THROUGH THE DISK. SHINE THE BEAM OF LIGHT AT A SCREEN ABOUT FOUR FEET AWAY,. HANG A BASKETBALL FROM A STRING IN THE PATH OF THE LIGHT. OBSERVE THE SHADOW THAT FORMS. REPEAT, MOVING THE PROJECTOR EIGHT FEET FROM THE SCREEN AND OBSERVE.
2. REPEAT WITHOUT THE DISK AND OBSERVE.
3. REPEAT THE EXPERIMENTS USING THE FOLLOWING OBJECTS CTS TO BLOCK THE LIGHT: A BASEBALL, A PING-PONG BALL; TWO SQUARE CARDBOARDS (3X3" AND 6X6") , AND A CUTOUT OF A CLOWN. OBSERVE THE SHAPES AND SIZES OF THE SHADOWS. ARE THEY RIGHT-SIDE UP?

QUESTIONS:
WHICH LIGHT MAKES A SINGLE SHARP SHADOW?
WHAT CAUSES TWO SHADOWS TO FORM ? IS THERE ANY DIFFERENCE IN THE SHARPNESS OR DARKNESS OF THE SHADOWS?
WHAT MAKES THE SHADOWS LARGER OR SMALLER ?
HOW CAN YOU TELL IF THE SHADOWS ARE RIGHT-SIDE UP?

A CIRCLE OF EIGHT LARGE PLASTIC HEADED PINS NEEDS TO BE PLACED AT EQUAL INTERVALS AROUND A 10 " PENCIL DRAWN CIRCLE. THE MODEL SHOULD BE PLACED IN A LIGHT OR THE SUN LIGHT TO FORM SHADOWS . TRY THE FOLLOWING:

1. SEE IF YOU CAN GET ALL THE SHADOWS OF THE PINS TO POINT IN THE SAME DIRECTION.
2. HOW CAN YOU GET ALL THE SHADOWS OF THE PINS TO POINT OUTWARD-AWAY FROM THE CENTER OF THE CIRCLE?
3. HOW CAN YOU GET ONLY ONE SHADOW TO LIE INSIDE THE CIRCLE?

ANSWERS THE STUDENTS MIGHT DISCOVER FROM THEIR OBSERVATIONS:

1. THE STUDENTS WOULD HAVE TO EXPERIMENT WITH A PARALLEL BEAM OF LIGHT SUCH AS A SPOT LIGHT OR USE SUNLIGHT.
2. A SMALL LIGHT WOULD HAVE TO BE PLACED IN THE CENTER OF THE CIRCLE.
3. A SMALL LIGHT WOULD HAVE TO BE PLACED OUTSIDE THE CIRCLE BEHIND ONE PIN.

LANGUAGE DEVELOPMENT:
LOOK FOR OTHER SHADOWS IN THE STUDENTS' LIVES. EXAMPLE: HOLES IN SHADOWS, COLORED SHADOWS, AND CRAZY SHADOWS.

BLACK BOX ACTIVITY ELECTRICAL CIRCUITS

BY

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BLACK BOX ACTIVITY
ELECTRICAL CIRCUITS

PURPOSE

In this activity the students. will:

Learn what an electrical circuit is.

Learn that electricity travels in paths.

Build a device to test electrical circuits.

Discover the pattern of an electrical circuit and draw it.

OVERVIEW

In this activity students will use the testing device they build to determine what the path of electricity is on various circuit boards. They will not be able to see the circuits therefore they will need to discover the path the electricity takes by using two probes connected to a dry cell and a light bulb to determine which points the electricity can travel between. There will be six holes on each card and the students will discover and draw the path between them that the electricity flows . There will not be a connection between some of the points. The students drawings will be made on a separate piece of paper. Each group of students will test 7 cards. This can be done as a lab activity in small groups, or it can be used as a center in the classroom ,for a unit on electricity.

MATERIALS

1 circuit board per team

one dry cell, size D

one dry cell holder, size D

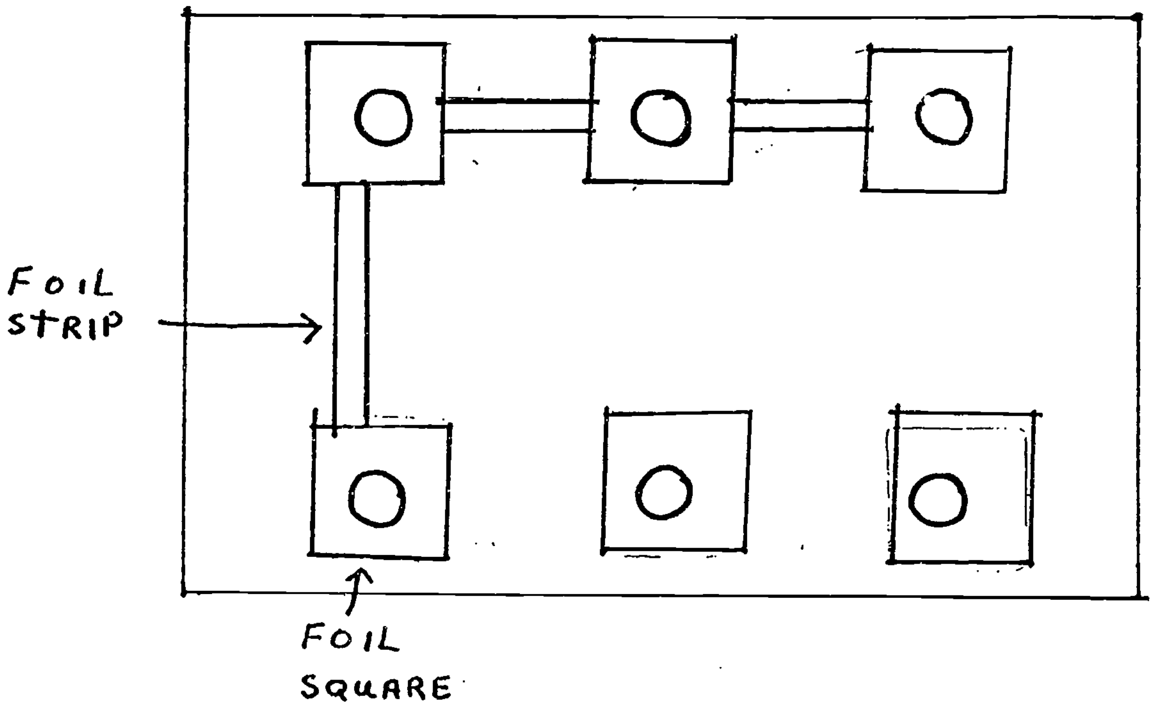
one light assembly

3 , 6 inch lengths of electrical wire.

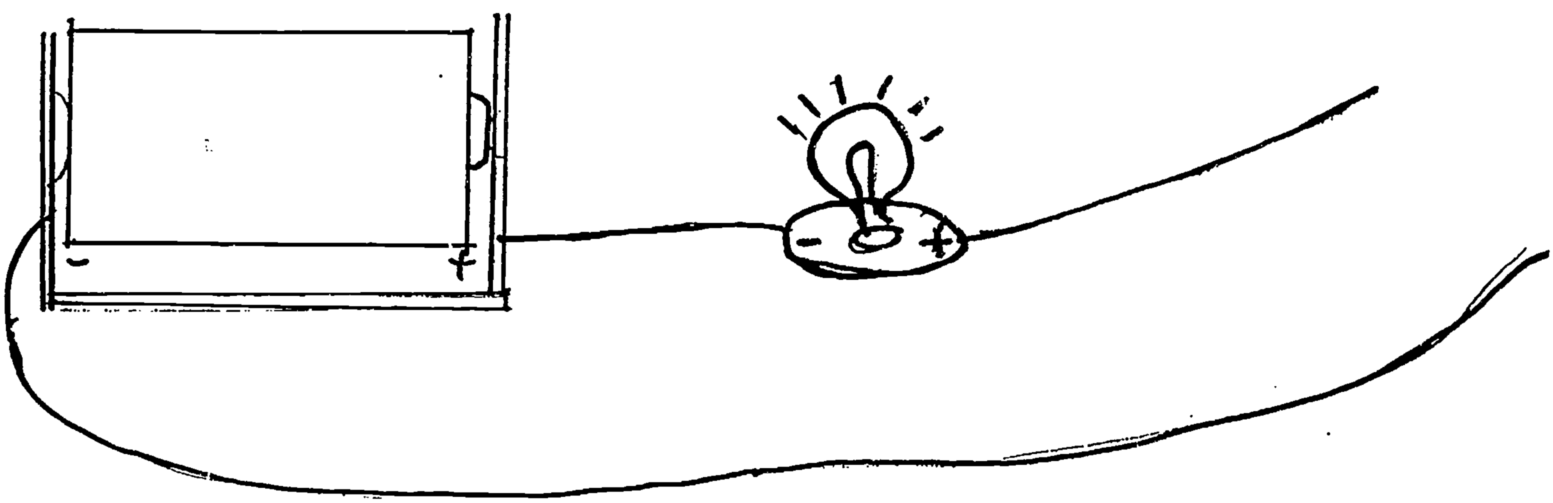
1 answer card for each circuit board tested.

GETTING READY

Prepare the circuit boards. Punch 6 holes, 3on each side of the 5x7 card with a three hole punch. The holes on each side should be equal distance apart. Then glue 2cm squares on the tab board where the holes on the 5x7 would be. Glue strips of foil between the some of the squares of foil to make an path for the electricity to flow. Then put the card with holes over the circuit board so the holes line up over the squares of foil. tape the cards together along the edge using masking tape or electrical tape, making sure not to cover the holes punched in the card. Make at least 7 different patterns/electrical circuits. Code each card with a number and make a drawing of that pattern on a separate card to show where the foil is because these strips will be covered with the 5x7 card with the holes punched in it. See the attached diagram circuit board example



circuit tester



DOING THE ACTIVITY

1. The students are in groups of four at lab tables. They have four different roles. leader, materials/clean up, data recorder and measurement taker.

2. Introduce the activity and teach what a simple circuit is.

3. Show the students how to assemble the circuit tester and test each circuit by touching the ends of the wire to two points on the circuit board where the holes are punched.

4. Test all points on the circuit board to determine the paths where electricity could flow.

5. Draw the circuit as you think it looks on a piece of paper.

6. Continue this process until you have tested and drawn 7 different circuit boards. Share circuit boards with other groups.

7. Make sure each student gets an opportunity to test a circuit board and draw the pattern the electricity could follow.

REFLECTING ON THE ACTIVITY

The students will summarize the activity by checking the patterns they have drawn and comparing them with the teacher prepared answer cards. The students will identify errors on their drawings.

They will explain why this method of testing circuits works.

BLACK BOXES GRADES 6-9

BY

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KADENA MIDDLE SCHOOL

BLACKBOXES GRADES 6-9

OVERVIEW

Blackboxes is an exercise in inductive reasoning. The scientific method is a problem solving process based on inductive reasoning. Reasoning by induction occurs when many facts are brought together to produce a general concept. The many variations of the blackbox allow students to question, probe, measure, feel, and use many other techniques to discover the contents of the blackbox. The following activity is another form of this mode of thinking.

PURPOSE

Students will be expected to

- Gain experience with the concept of blackbox.
- Gain experience with questioning as a means of problem solving.
- Synthesize many facts to form an idea of the contents of the blackbox.

MATERIALS

- WOODEN MICROSCOPE BOX, PAINTED BLACK.
- OBJECT INSIDE BOX WHICH CAN BE CHANGED AT THE END OF THE ACTIVITY.
- STUDENTS NEED PAPER TO TAKE NOTES AND WRITE DOWN THOUGHTS.

DOING THE ACTIVITY

This activity is designed to be a class group activity with every student participating and the teacher being the responder to questions.

This blackbox is a variation of "20 questions". The number of questions to be allowed will be two per student or double the number of students in the class. If a student chooses not to use both questions, other students may use them as long as the maximum is not exceeded. Questions must be in yes or no answer form. The teacher will answer questions ui. , the maximum has been reached. Students are to write down what they think is in the box when they have an idea, no one is to shout out ideas until all questions have been asked.

After all questions have been asked the contents of the box can be revealed. I suggest a small prize be given to any student with the correct contents of the box written down.

REFLECTING ON THE ACTIVITY

Students that by mistake ask a question that is not answerable with a yes or no will lose that question. If a student gives away the contents to the class, the box can be refilled and that student will be exempt from the resumed activity.

This activity was conducted in an eighth grade science classroom with a football as the contents of the box. It was discovered that most students had no clue until someone asked a very revealing question. At this point, the questions became more focused productive. 24 students were in this particular class and after 48 questions, most concluded that a football was indeed contained inside the box. A reward of a "jolly-rancher" was given to each student with the correct answer.

The black microscope box idea could be used in a variety of ways. One idea is to have students in small groups feel, shake, weigh, or probe in many ways short of opening the box. The object would be for the group to develop a concept of the contents and draw a picture of the contents to share with the entire class. Ideas from other groups could then be compared.

WAYS OF KNOWING
ACTIVITY 2
THE BLACK BOX

BY

TIMOTHY J. CONNORS
KINNICK HIGH SCHOOL

by Timothy J. Connors
Kinnick High School

BLACK BOX EXPERIMENT **ACTIVITY - 2**

PURPOSE

In this investigation the students will
* Investigate a "Black Box".
* Be able to work together in cooperative groups to discover how a "Black Box" works.
* Determine the various alternatives to the workings of the "Black Box".
* Provide various alternatives to the workings of the "Black Box".
* Gain experience working as a cooperative group to solve problems.

OVERVIEW

In this investigation students will be given a problem to solve known as a "Black Box." In order to solve the problem, the students will be assigned to cooperative groups and will work within that group to solve the problem: "How does this "Black Box" work? The "Black Box" consists of a sake dispenser which resembles a ceramic teapot. The sake dispenser will only pour as much liquid as a small sake cup will hold. However, each time liquid is poured from the sake dispenser, the same measured amount is obtained in each small sake cup. The students problem is to explain how this works. Students will be asked to come up with a diagram to explain the phenomenon.

BACKGROUND FOR THE TEACHER

Students always seem to be excited when given a problem to solve. It enables them to see things that look strange and mysterious while at the same time presenting a challenge to them that they can solve. In this activity the students will be observing a "Black Box" in an Asian manner of thinking. The students will be able to work together in cooperative groups to discover how the sake dispenser works. The students will be asked to devise a diagram showing the internal structure of the sake dispenser and then they will explain their thinking to the class. They should discover that there will be a variety of possible solutions to their problem, but only one answer will be correct in terms of this particular "Black Box." As a further investigation of this type of problem, perhaps students could devise and/or construct their own "Black Box."

The students will enjoy searching for solutions to this problem. To make sure that each student meets with success, it will be important to have students work in cooperative groups. Working alone, students may have a difficult time coming up with possible solutions. However, working together in groups should make the task less stressful for some. The sake dispenser used was obtained in Okinawa where it is a common article. There is also a ceramic cup that is a "Black Box." When the cup is filled to full, the liquid escapes through a hole in the bottom. If there is less liquid in the cup, no overflow occurs. The purpose of the cup is to prevent someone from becoming too greedy and taking too much sake. Those who drink in moderation will not end up with sake on their body. Those who take too much sake will end up with most of it on their clothes. Have plenty of paper, markers, and pencils available for students to use as they consult with one another and devise possible solutions.

MATERIALS

For each group of four students
- drawing paper or poster paper
- colored markers
- pencils

For the class:
- Black Boxes, e.g. sake dispensers (see figure below):

GETTING READY

1. **Schedule the Activity.** This activity is in one part. You may find that it takes fifteen to thirty minutes to complete this and additional sessions for the extensions.

2. **Purchase or construct the "Black Box".** collect or construct a variety of "Black Boxes".

3. **Gather materials.** Have the necessary poster paper, markers and pencils available.

STUDENT SHEETS

1. **Data Sheets.** No special data sheets are required. Students may record their answers and drawings on their paper and/or posters.

DOING THE ACTIVITY

PART ONE: Observing the "Black Box>"

1. **Form Collaborative groups.** Organize your class into cooperative groups of four. Discuss the four jobs within the groups: GETTER, STARTER, READER/REPORTER, RECORDER. Tell them that each group will present their results at the conclusion of the study.

2. **Introduce the Activity.** Inform the students that they will be starting a new science activity today. They will be asked to view an Okinawan Sake Dispenser to determine how it works. they will be asked to demonstrate their expertise in solving the problem by drawing a detailed sketch indicating how the sake dispenser works. They will also be given the opportunity to report to the class on their findings.

3. **Distribute Materials.** Have the GETTER from each group to come to the materials station to get materials for the teams. (Paper, markers and poster paper can be placed on tables prior to class.)

4. **Demonstration.** Demonstrate to the class how the sake dispenser works by first filling the sake dispenser and then pouring sake into the small sake cups. Do this several times so that everyone can see the problem.

5. **Introduce the concept of a "Black Box."** Introduce the concept of "Black Boxes" to the class by showing pictures or illustrations of other types of "Black Boxes" that they may encounter during the activity. If possible use actual samples of other "Black Boxes" which students may work on after they complete this project.

6. **Challenge.** Present the challenge to the students: *How does the sake dispensers work? Discuss in your group the possible solution for how the sake dispenser is able to dispense the same amount of sake each time even though there is still sake in the dispenser?* Ask the students to diagram their answer and be able to present their findings orally to the class.

7. **Drawings.** Have the students draw and color their solutions for the problem. Have the students label their drawings.

8. **Discussion & Conclusion.** Have the teams meet to discuss their drawings to make a list of the possible solutions to the problem. On a large sheet of paper have students make drawings illustrating the various ways the "Black Box" work. Each team should present their findings to the class for discussion. After all discussions and presentations have taken place, have the students vote on the one idea or concept that they think is the best. Then explain to the

students how the sake dispenser works!

REFLECTING ON THE ACTIVITY

1. What methods were used by various groups to solve the problem? How did different groups attach the challenge?

2. Were other methods devised to solve the problem that would also work? Perhaps as an extension these students could construct a "Black Box" using their own criteria.

3. What are some "Black Boxes" that students come across in their daily lives?

4. Based on your findings, could you construct a different type of Black Box"?

VOCABULARY DEVELOPMENT

Black Box: a mysterious devise which defies logic on first examination.

LANGUAGE DEVELOPMENT

1. **Teach Peers.** Have one or more students demonstrate to other students how a "Black Box" works. Students could work in pairs to explain the concept to others.

2. **Make a "Black Box" Bulletin Board.** Have students make a display poster for the bulletin board that shows various types of "Black Boxes." The poster should include:
   * a title
   * a definition of a "Black Box"
   * pictures or drawings of various "Black Boxes"
   * a question for readers to think about, such as "How do these objects work?"

MATHEMATICS DEVELOPMENT

1. **Organize the portions of sake.** Have the students make a chart of the amount of sake that is dispensed from the sake dispenser. The students could measure in milliliter (mL). The chart may look like this:

Amount of Sake (mL)	Trial Number
15.0 mL	1
14.5 mL	2
14.0 mL	3
etc.	

EXTENSIONS AND APPLICATIONS

1. **Compare other types of "Black Boxes."** Have students do the same activity, but substitute different types of "Black

Boxes" and make a list of similarities and differences.

2. **Construct "Black Boxes."** Have students design and construct their own "Black Boxes". The students could then exchange their "Black Boxes" and have other students try to determine how they work.

BLACK BOX EXPERIMENT

BY

DAVID D. HUFFMYER
ZAMA HIGH SCHOOL

BLACK BOX EXPERIMENT
Science Course III
Mr. Huffmyer
Zama High School

Purpose: To explore the properties of magnetism in a "black box" experiment.

Objectives: (1) Find the location of some unknown magnets using a compass as a tool. The students will be able to discover magnetic fields by exploring an unknown location with a compass, a piece of paper, and a pencil. (2) The students will use compass skills much like those used in orienteering.

Materials: Per group of students

A table stand

A piece of cardboard

Sheets of drawing paper

4 magnetic marbles

4 compasses

1 petri dish with iron filings (extension)

Pencils

Getting ready:

1. Prepare the activity boards; stands, cardboard, drawing paper and magnetic marbles.

Time: 1 30-minute session for the activity. Variations can extend the time involved.

2. Prepare the exploration. Have materials at each station so students can rotate through 2-3 different activities and make predictions about the arrangement of the magnetic marbles.

Doing the Activity:

(1) Review the properties of magnetism and like - unlike poles

(2) Have students move a compass over magnetized spheres and notice the needle deflection when the compass is directly over the sphere.

(3) Some of the students in a group will arrange their "black boxes" by setting up a stand (see figure) and positioning magnetic marbles under the stand.

(4) The remaining students will be doing the activity as they position compasses over the stand and discover the location of the pre-positioned magnetic marbles. The students will need to use compass skills, as well as, the indicators they learned in step 2. They will record their results in step 5.

(5) Each magnetic marble will be located and marked on a blank sheet of xerox paper and the students will move on to the location of the next one. When the students have made their predictions about the locations they can move on to the next station. The actual position of the marbles will remain unknown as student develop confidence in their ideas and ability to

reason.

(6) A closing discussion about the experiment and the methods of discovery include technique and ideas.

Extentions

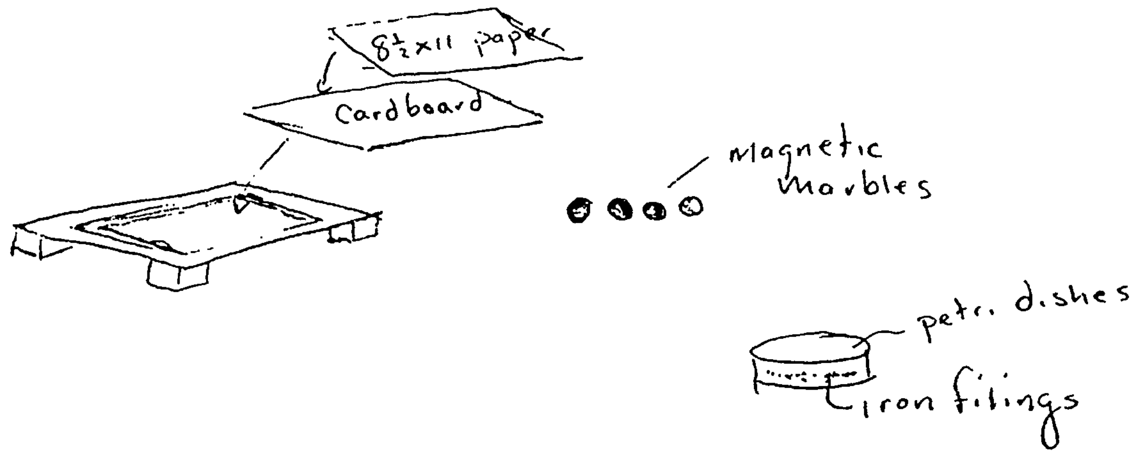
(1) A larger experiment can involve tracing magnetic objects under the stand using petri dishes with iron filings.

(2) Unknown magnetic shapes can be located and traced using a table and a petri dish containing iron filings. The shapes are placed under the table so that the students must use the indication of magnetic fields as the dish is passed over the objects.

(3) The tracing is then done on the drawing paper and a hypothesis can be made on the shape and location.

(4) The results can be examined by the student to asses the degree of success.

Drawings:



Reflecting on the Activity:

(1) Discuss the unknowns involved in this activity.

(2) Think of some systems that are not fully understood like "black boxes".

(3) How are some of the methods used to reason through a "black box activity like trying to discover how a video game works or how a shape is made up of smaller puzzle shapes.

THE HANDS DOWN METHOD OF RANDOM SAMPLING OF ICEBERGS FOR POLAR BEARS AND ICE HOLES A BLACK BOX ACTIVITY

BY

MARY BAKER
KINNICK HIGH SCHOOL

THE HANDS DOWN METHOD OF RANDOM SAMPLING OF ICEBERGS
FOR POLAR BEARS AND ICE HOLES
A Black Box Activity

Strand: Scientific reasoning and technology

Science Concepts: Sampling techniques, discovering patterns, estimating, critical thinking, problem solving, collaboration

Science Thinking Processes: Observing, communicating, comparing, organizing, and relating

Interdisciplinary Activities: Language and math

PURPOSE: Students will make observations, develop and test patterns, and communicate ideas thereby building on an idea with group effort and cooperation.

OVERVIEW: In this activity, students in groups of four, will discuss the term "random sampling" and decide on a definition. Students will identify the need for such a sample in nature. The small groups will then come together in a single group setting to practice a random sampling activity. The purpose is to demonstrate how scientists may determine how many polar bears congregate at ice holes on icebergs and in the process they will use a wide variety of concepts.

BACKGROUND FOR THE TEACHER: This activity represents an unknown that is completely visible, yet until the pattern is broken, it may seem completely incomprehensible. Individual ideas grow and change as they are tried by group members, thus the notion that ideas evolve more quickly within group collaboration is demonstrated. Once a pattern is determined, every member can participate and feel successful in solving what at first seemed a very difficult task. With cooperation, the problem becomes a simple case of observation and addition and hopefully will encourage students to strive to work together and have a good attitude and thinking and problem solving.

MATERIALS: about five dice

GETTING READY:

1. Schedule the activity. This activity started out as a 10 minute sponge activity for the beginning or the end of class on 2-3 consecutive days or when convenient, but has evolved into and may be used as three 30 to 45 minute lessons depending on the number of rounds and how many concepts are used and stressed. The activity does not have to be conducted on consecutive days. Some students will ask questions about ideas that have been going through their minds about the activity thereby increasing the amount of thinking that is going into the activity.

2. The room setting should be such that groups of four can be utilized and then the entire group can come together so that they may all see the dice and work toward a solution. If the class is large, have an inner seated circle, and a standing outer circle.

DOING THE ACTIVITY:

PART 1: Introduce the term "random sample" to the class. Encourage the students to define and discuss the term and its uses in groups of four. Ask the students how random samples may be used in various scientific (example: determining numbers of endangered animals in a large park) and in other situations (example: Which drink do more people prefer, Pepsi or Coke?).

2. Bring the class together as one large group. Set up the scenario of a pilot/zoologist hired to randomly sample polar

bears and ice holes on icebergs in an area of the Arctic ocean. The pilot has only enough gas to cover 1/10 of the area.

3. The teacher should be kneeling (sitting on heels) on the floor with his/her fingers spread out on the floor as the last few instructions are given or questions elicited. The five (or so) dice should be beside the teacher. Instruct the students to observe carefully and be sure not to talk out. Choose any number of the dice and roll them out into the circle so that everyone in the group may see.

Example: ice holes -2  polar bears -4

polar bears -2

icebergs -6  

4. As the teacher brings his/her hands back to the floor in front of him/her, rest the fingers on the floor to form a number 0-10 in a very casual manner. Look around the group and question 1 or 2 students about how many icebergs they count. They will most likely respond to the number of dice that were thrown. Praise correct responses and casually correct incorrect responses. Next question various students about the number of bears and ice holes. (Reminder to the teacher: the dot in the center is an ice hole and any other dots are polar bears). Play up the answers and ask the group for agreement, then very clearly give correct responses. Mark down the numbers for each iceberg, polar bear, and ice hole on the board.

Example:   icebergs polar bears ice holes

5. Go through the arrangement a total of ten times. Look for

signs of frustration and remind the students that it takes time and careful observations to notice patterns. Praise ideas that show that thinking skills are being used even if they are totally wrong.

6. Discuss how the data should be used to make an estimation of the number of icebergs, polar bears, and ice holes there are in the area if only 10 percent was sampled.

7. Close part one of the activity by discussing the purpose of the activity and recalling any signs of a consistent pattern.

PART 2:

1. Follow the same procedure as in part one, but for these rounds, stress that name of the activity. Make the announcement several times that this is the "**hands down** method of random sampling".

2. Stress the sharing of ideas and praise attempts to use thinking skills.

3. Make sure that everyone is "in on" the hands down part of the activity before ending the rounds. Encourage students to discuss their individual feelings about information they shared with the group in an attempt to solve the problem that turned out to be "wrong". Get the students to realize that "wrong" ideas are beneficial. Encourage the students to be confident in sharing ideas and discuss the benefits of keeping an open mind when problem solving so that good ideas are not tossed out too quickly and to reduce the amount of the time spent going down "the wrong road."

4. Discuss the results of the estimation for the rounds today as

compared to part one and close the activity..

PART 3:

1. By this session, students have usually discovered the pattern of determining the number of icebergs. They are feeling successful and will continue to think about the pattern that will reveal the number of polar bears and ice holes.

2. Stress that the bears are **around** the holes. Encourage the sharing of ideas and test the idea on each round.

3. After the tenth round, study the data taken each day. Discuss the estimation of icebergs, polar bears and ice holes figured for each day. Discuss the validity of a random sample based on the findings in this activity. Compare and contrast a real random sample to the activity done in class.

4. Encourage student to reveal how the activity would have been different if they had not been able to share their ideas with the group or been able to build on the idea of others in the group.

5. Close the activity by encouraging students to work together and discuss how the polar bear activity relates to problems in real life.

REFLECTING ON THE ACTIVITY:

1. Explain a random sample and the value of estimating in everyday life.

2. Develop a pattern of your o, to try on the class using dice or another manipulative or idea.

3. Relate this activity to patterns and problems that occur in everyday life.

4. How do individuals feel when problems seem too difficult to

solve? What can students do to avoid defeat when a problem seems too frustrating to continue attempting to solve?

VOCABULARY DEVELOPMENT:

black box: a system that cannot be seen into or understood easily.

random sample: a representative sample drawn from a population so that an estimation of total numbers can be deduced

*Be certain your students understand the meaning and are able to use effectively the following terms:

estimation pattern congregate endangered zoologist

LANGUAGE DEVELOPMENT:

1. Black Boxes

Students will be encouraged to look for black boxes in daily life. Topics may be suggested, such as black boxes in medicine might be a cure for AIDS and cancer. The ideas will be continually reviewed and discussed.

2. Frustration

Students will identify how black boxes may present a positive solution to difficult situations in a students personal life. Students often become overwhelmed to the point of giving up. Communicate in some way (drawings, letters, group discussion) how this common problem can be avoided or reduced.

SCIENCE AND MATH DEVELOPMENT:

1. Students will continually use estimation in class and be encouraged to make predictions about possible outcomes based on research and experimentation.

2. Provide time for students to research important scientific discoveries that were seemingly simple ideas, but have large complex concepts. Also point out that seemingly impossible problems are sometimes discovered, identified, and solved discovered accidentally. Examples could be Newton's discovery of gravity that lead to many other ideas, the discovery of penicillin, or principles that allow man to fly. Also provide opportunity for students to discover that ideas build on the ideas and work of others. It is important for students to see that by working as a group, many more ideas will be used and progress will be increased that when individuals are working and making minor discoveries on their own.

FOSS (FULL OPTION SCIENCE SYSTEM) FOR ALL STUDENTS:

VISUALLY IMPAIRED. Be sure to announce the number and arrangement on the dice.

HEARING IMPAIRED. Refer to numbers for each round listed on the board.

ESL or Learning impaired students maybe let in on a part of the secret prior to the activity to build self confidence and to help them become part of the group effort.

ACTIVITY OUTLINE:

1. Announce clearly the name of activity.
2. Introduce the situation.
2. Discuss the terms that will be used in the activity.
3. Form small groups then a large group and discuss rules.
4. Complete the first round and record the data.
5. Proceed through 9 rounds.

6. Help students avoid frustration.

7. Provide encouragement and assure students that there is an obtainable solution to this particular problem.

6. Discuss estimation and how it can be used with the data.

7. Discuss how the activity relates to life situations.

PART 2:

8. Follow that same procedure as in part one.

9. For these rounds, stress the name of the activity. Make the announcement several times that this is the **"hands down** method of random sampling".

10. Stress the sharing of ideas and praise attempts to use thinking skills.

11. Be sure that everyone feels successful before the end of the lesson if most students have figured out the icebergs.

PART 3:

12. Stress the fact that more ideas are available if students share with the group.

13. Stress the idea that "polar bears are almost always spotted **around** ice holes".

14. Make sure everyone feels successful.

15. Do a few rounds after the secrets are revealed.

16. Compare and contrast the estimation part of the activity.

17. Encourage students to create or share their own "polar bears" (black boxes).

18. Close the Activity.

BLACK BOX M ATERIALS IDENTIFICATION

BY

DAVID ROMPRE
ZAMA HIGH SCHOOL

ACTIVITY: BLACK BOX "MATERIALS IDENTIFICATION"

PURPOSE: In materials identification the student will

1. Make multisensory observations of black boxes.
2. Communicate ideas through discussion.
3. Develop a hypothesis based on previous knowledge.

OVERVIEW: In black boxes "materials identification" students work in groups of two to identify the contents of sealed black film containers. Students are asked to list their observations and to conclude what each box contains.

This activity was done with an eighth grade class of twenty students. A total of ten film containers were constructed using a variety of materials Each box was painted with an identification number at the top. Students were given three to five minutes to make and record their observations before switching boxes with another group. Eventually each student examined all ten containers. Since members of each group did not always agree or have the same observations, each student was asked to record their own observations. In addition, each student was asked to write down what they thought was in each of the containers. Students were given the option to draw a picture of the contents of each container.

I concluded the activity by asking students what they thought was in each of the containers and why. This allowed for some lively discussion and comparison of observations. Although students expected confirmation from the teacher as to the accuracy of their guesses, no absolute confirmation was given.

MATERIALS for black box materials identification.

10 empty film containers

1 role of black electrical tape

1 white paint pen

suggested content items for film containers:

marbles

ball bearings of various sizes

aluminum cubes

steel cubes

wood cubes

metal washers of various sizes

coins

paper clips

wood or metal screws

metal nuts

wooden dowel pieces

plastic buttons

BB's

*cotton balls (optional)

*a magnet to be supplied to students only if they request one for identification purposes.

GETTING READY

1. The actual exploration portion of this activity will require a full 45-50 minute period. Having students record their observations will make it easier to resume discussion the following day.

2. **Preparing the containers:** Once the necessary materials are located the actual preparation of the film containers is a relatively simple matter. There are a variety of options as far as materials or combinations of materials are concerned. I listed cotton balls as optional in the materials section in case you wish to them as a "dampening" material in one or more containers. Be sure the tops of containers are secured with electrical tape to prevent the curious from sneaking a peak.

3. Allow ample time for discussion and answer comparison at the end of the activity.

4. Don't forget to make a list for yourself as you fill the containers with various objects.

MILK CARTON MADNESS

BY

LELAND WALBRUNCH
EDGREN HIGH SCHOOL

EDGREN HIGH SCHOOL MODULE #1
Mr. Leland "Wally" Walbruch

GRADE 7-9

MILK CARTON MADNESS (Black Box)

ACTIVITY #1

STRAND

Scientific Reasoning

SCIENCE CONCEPTS

Thinking Process
Controlled Equipment
Variable

SCIENCE THINKING PROCESS

Categorizing
Observing
Comparing
Organizing
Relating

PURPOSE

In "Milk Carton Madness" the students will:

Investigate an unknown using various senses

Gain experience with variables

Conduct a controlled experiment

Gather and organize data in order to draw conclusions

Learn concepts that will contribute to understanding of the following themes

THEMES

Pattern
Structure
Change
System

OVERVIEW

Science is a body of information including all the hypotheses and experiments that tell us about our environment. All people involved in scientific work use similar methods of gaining information. One important scientific skill is the ability to obtain data from the environment.

Observations must be based on what actually happens or what we perceive happens in the environment. Equally important is the ability to organize this data into a form from which valid conclusions can be drawn.

BACKGROUND FOR THE TEACHER

Science is not just a collection of facts for students to memorize. Rather it is a process of applying their observations and intuitions to situations and problems formulating hypotheses and drawing conclusions. "Milk Carton Madness" invokes the thinking processes.

What are the thinking processes. The most basic process is observing.

Through observation - seeing, hearing, touching, smelling and tasting - the student begins to gather information regarding size, shape, texture, or quality of an object or event.

The following statements may begin to assist students to focus their observation.

"What does the object sound like?"

"What shape is the object or container?"

"What characteristics can you observe?"

Students can then begin to organize the information acquired through their observations. This process of organizing information encompasses ordering, organizing and comparing. When ordering information events are placed in a sequence that tells a logical story. By looking at similarities and differences, objects, or ideas can be compared.

Next students will become involved in the process of inferring. Inferences are logical conclusions based on observations and are made after careful evaluation of all the available facts or data. Inferences are a means to explain or interpret observations. Have students focus on the process of inferring by asking the following questions:

"What can you infer from the data gathered during this experiment?"

"Discuss within your team the data that supports your predictions."

This leads to the communication part of science. Once information is gathered it is necessary to organize the observations or inferences. This information may be presented in tables, charts, models and diagrams which make it easier to consider the facts. The following questions may assist students in this process:

"Compare what is happening inside each of the milk cartons."

"Diagram and share your inferences about the inside of the milk carton."

"Contrast the milk cartons."

Another process that is important is "relating" cause and effect. This process focuses on how events or objects interact with one another. It also involves examining dependencies and relationships between objects and events.

Use the following questions to invoke this thought process.

"Is there a relationship between where they were found and the difference in the container?" "Why or why not?"

MATERIALS

For each group of four students

4 milk cartons labeled: *

A (Found in garbage can within cafeteria
B (Found on sidewalk outside of cafeteria)
C (Left on table in cafeteria)
D (Found on floor of cafeteria

* Please note the variable of where carton was found is added because of a lunch time cleanliness problem that we have experienced at Edgren High School. I found it was a great way to discuss the problem and variables at the same time.

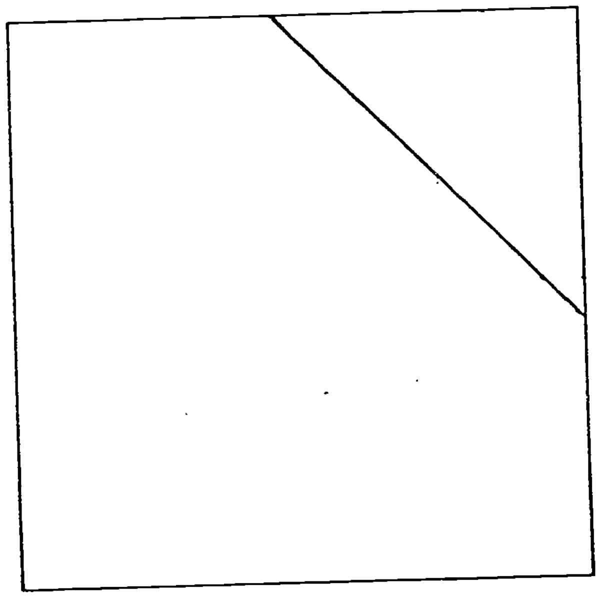
GETTING READY

1. Schedule the activity. This activity will take one 50 minute session to complete. Additional time might be necessary if students are expected to report their findings and conclusion to the total class.

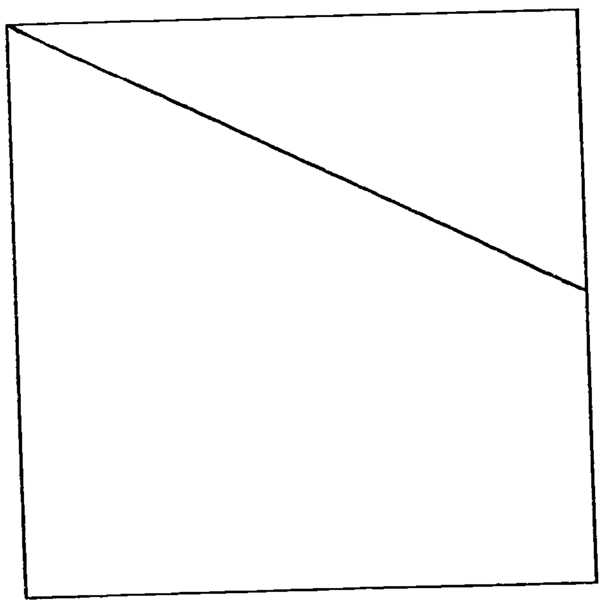
2. Construct "Milk Carton Madness" containers

Use milk carton parts to make the divisions in each container

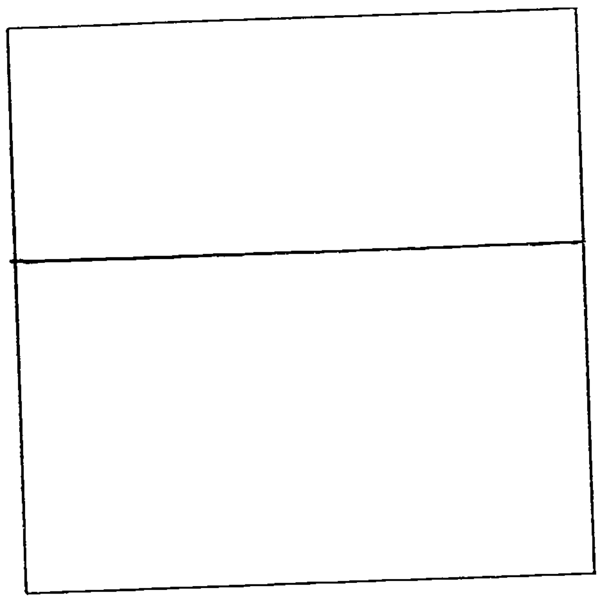
A. Top view of carton, a barrier is glued (use hot glue for best resulcs) Place a glass/steel marble in the largest area of the carton.



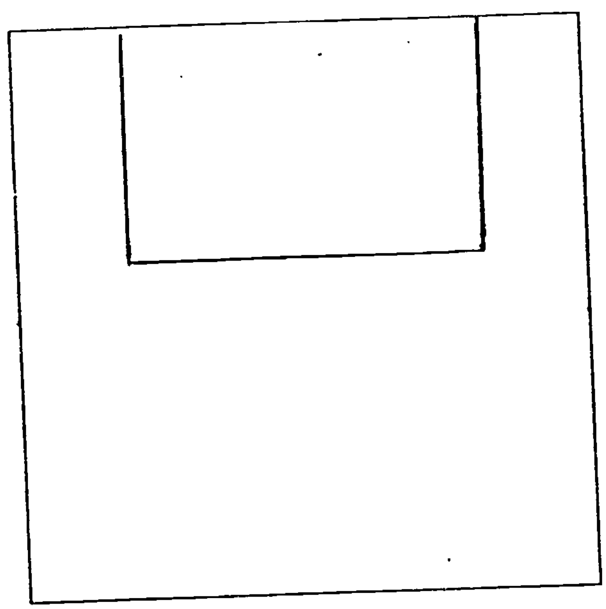
B. Top view of carton



C. Top view of carton



D. Top view of carton



OBSERVATION SHEET

Name______________________________ Date:______________

MILK CARTON MADNESS

Write a complete description of the contents and a diagram based on your inferences. (DO NOT OPEN THE CARTON)

CARTON A: (Found in the garbage can within the cafeteria)

CARTON B: (Found on sidewalk outside of cafeteria)

CARTON C: (Left on a table in cafeteria)

CARTON D: (Found on floor of cafeteria)

DOING THE ACTIVITY

Part 1: Form Work Teams

Organize your class into work teams. Random selection by draw of playing cards might be desirable.

Part 2: Introduce the Activity

Explain to the students the problem of finding milk cartons at various places near the cafeteria. Discuss that each milk carton appears to be different. Their task is to find out how they are different from each other.

Part 3: Distribute the Student Data Observation Sheet "Milk Carton Madness:

Part 4: Explain to the students that answering specific questions for each of the cartons might be an excellent method to begin with.

Examples include:

"What does the object sound like?"
"What shape is the object or containers"
"What characteristics can you observe?"
Compare what happens in each of the milk cartons.
Contrast what happens inside each of the milk cartons.
"Is there a relationship between where they were found and the differences in the containers? Why or Why Not?"

Part 5: Report each groups observations to the class

REFLECTING ON THE ACTIVITY

To begin have students individually complete the "Milk Carton Madness Performance Checklist". This will allow students to reflect on their personal involvement on the team and may be used as an assessment tool.

Self-management
Problem Solving
Leadership

NAME: CLASS: DATE:

"MILK CARTON MADNESS" PERFORMANCE CHECKLIST

Poor 1
Average 2
Above Average 3
Excellent 4

Student Self-check		Teacher
	Self Management	
1 2 3 4	Exhibits Self Control	1 2 3 4
1 2 3 4	Organizes Tasks, resources and self	1 2 3 4
1 2 3 4	Perseveres in completing the task	1 2 3 4
	Problem Solving	
1 2 3 4	Defines the problem	1 2 3 4
1 2 3 4	Develops background information on the problem	1 2 3 4
1 2 3 4	Evaluates the alternative solutions	1 2 3 4
	Leadership	
1 2 3 4	Organizes group	1 2 3 4
1 2 3 4	Involves all group members	1 2 3 4
1 2 3 4	Contributes to completing task within scheduled time	1 2 3 4

BLACK BOX ACTIVITIES FOR

GRADES SEVEN - NINE SCIENCE PROGRAMS AND BEYOND

A SUPPLEMENT FOR SCIENCE
1, 2, & 3

Department of Defense Dependents Schools
Pacific Region

INTRODUCTION

Black Box Activities for Grades Seven - Nine Science Programs and Beyond is a collection of activities developed by inservice teachers employed by the Department of Defense Dependents Schools Pacific Region who took part in a science program inservice held at Kadena Air Base Okinawa, Japan during September 1993. The inservice progran was designed and conducted by Manert Kennedy and James Hubbard of the Colorado Alliance for Science, University of Colorado, Boulder, CO 80309 with funding from the Department of Defense. The activities are intended to supplement the Science Interactions Course 1, ISBN 0-02-826032-5, 1993, Science Interactions Course 2, ISBN 0-02-826098-8, 1993, and Science Interactions Course 3, ISBN 0-02-826107-0, 1993 hands-on science programs published by Glenco .

All activities included in this publication are in the unedited form. Credits for the activities are provided at the beginning of each activity.

As we are aware, science is a process by which people attempt to describe the universe in which they live. In many cases the descriptions provided by the evidence available allows only tentative descriptions, open ended at best. We accept those descriptions only for the present, agreeing that we are willing to change them once additional evidence indicates a need for modification. The activities included herein are intended to help students come to the realization that science many times does not provide us with exact descriptions of phenomena or answers to questions but only allows to make educated guesses.

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CONTENTS

THE MYSTERY BOX

BY

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THE MYSTERY BOX

Mysteries have challenged the best minds among archaeologists, anthropologists, alchemists, climatologists, linguists, and historians since the beginning of time. Going back to the time when men saw a wooden nymph in every tree and magnificent figures among the stars, to the time when they looked for a UFO on every clear night, mysteries have held their grip on human imagination. Mysteries and curiosities have held their grip on human imagination and have probably contributed to the accomplishments of many great scientists. The best description of mystery was given by Albert Einstein over 60 years ago. He stated that the most beautiful thing that can be experienced is the mysterious; it is the source of all true art and science. Those who are strangers to this emotion, who can no longer pause to wonder and stand rapt in awe, is as good as dead; their eyes are closed.

Since people have such great appetites for mystery, why not take advantage of the opportunity to attract the interest of students.

Purpose

During this activity, students will;

1. Use the appropriate senses to observe the mystery box.
2. Develop mental models based on their observations.
3. Discuss the structure and appreence of the interior of the box.
4. Diagram their idea of how the box look inside and give a written description of the interior of the box.

Materials

1 large box(30"x30"x30")
Duct tape and masking tape
Styrofoam pieces
Plastic heads of black cats(2)
Medium size plastic human skulls(2)
Stiff cleaning brushes(2)
Rubber water hose(3 meters)
Small wooden chair from doll house
Troll doll
Nerf balls(2)
Large fuzzie spider
Large sleev^(18 inches long)
Cans of sp paint(black and red)

The materials above can be arranged as desired and secured with duct tape or masking tape.

Procedures

1. Place the mystery box on display so that all students can see it as they enter the room. Give no explanation, or answer any questions for at least one day. Allow the imaginations of the students to run wild for at least one day.

2. Form teams of 4, two observers and two designers. Ask each team for suggestions as to how they can determine the structure of the interior of the box.

3. Rules:
   a. Each observer will be allowed to examine the interior of the box with one hand. There will be a time limit of 30 seconds.

   b. No one is allowed to peak in the opening of the box. This opening must remain covered at all times. If any observer attempt to look inside, the team will be disqualified.

4. After examining the inside of the box, the designers will draw the inside based on the descriptions given by the team's observers. Teams must also give a written description of the interior of the box.

5. Display the descriptions and designs of each team and allow them to ask and answer questions.

Results And Conclusions

The box was prepared and all items were held in place by the masking and duct tape. An opening was cut in the side of the box. This openine was large enough for a person to place an arm inside without any difficulty. The opening was covered with a sleeve shaped piece of black fabric. The sleve was covered with a card board flap that could easily be lifted.

The box was displayed for 2 days and students' curiosities were running wild. After the second day the activity was carried out. All students were excited about the activity and wanted to be the one to examine the inside.

Thsi activity was exciting, interesting and fun. It encouraged students to work together as a team and required them to rely on their sense of touch to develop a diagram of the mystery box.

The box remains closed and students are still wondering about the contents. They have been informed that most of them had the right idea. They were all encougaged to design and build their own mystery oox.

Suggestion For Additional Model

A mystery box could be developed for K-3 grades. To do this, a large crawl through box would be needed. This box should be a very large one from large appliances. There should be an opening on both ends. Each opening should be covered by a dark curtain so that light cannot get in. An alternative would be to make a tunnel leading into the box. The box should be dark inside. A variety of large stuffed animals and other soft fuzzy creatures and items should be placed in various locations inside the box. One student at a time should be allowed to crawl through to examine the inside with their hands. A time limit of one minute should be allowed for each student. When all members of a team have explered the dark interior of the mystery box, they should work together to give a description of the inside. Students can give verbal descriptions, written descriptions, or make a diagram.

A BLACK BOX

BY

GARY GEORGE
ZAMA HIGH SCHOOL

SCIENCE ACTIVITY

A Black Box

PURPOSE

IN THE BLACK BOX ACTIVITY THE STUDENTS WILL

* MAKE MULTISENSORY OBSERVATIONS OF BLACK BOXES.
* DEVELOP CONCEPTUAL MODELS OF BLACK BOXES.
* COMMUNICATE MODELS THROUGH DISCUSSION AND DRAWING.
* CONSTRUCT CONCRETE MODELS TO COMPARE TO CONCEPTUAL MODELS.
* LEARN CONCEPTS THAT WILL CONTRIBUTE TO UNDERSTANDING OF THE FOLLOWING THEMES:

STRUCTURE

INTERACTION

and

SYSTEM

SCIENCE CONCEPTS: 2

BLACK BOX MODEL

SCIENCE THINKING PROCESSES:

* OBSERVING
* COMMUNICATING
* COMPARING
* ORGANIZING
* RELATING

INTERDISCIPLINARY ACTIVITY:

* LANGUAGE

OVERVIEW

All the boxes you and your classmates will use in this experiment are the same. The first step is to find out as much as you can about these boxes without pulling the rods out of the boxes and with out opening them. Look at one of them, shake it lightly, tilt it back and forth in various directions, and listen carefully to the sounds. you will find it very useful to write down your observations. This will help you to compare notes with your classmates so that you can arrive at a model, make predictions, and test them.

The class is presented with a set of two boxes labeled A. and B. with three rods extending out two running horizontal and one running vertical. Students work in two groups to determine what is inside. After 15 minutes, a student from each group draws a picture on the board (model) that explains what the pair thinks the inside of their box looks like. After further investigation and discussion by the class a spokesperson for each group draws the consensus model for what the group thinks the box looks like inside. The activity concludes with a discussion of models, sensory information, and the method for improving the models.

DOING THE ACTIVITY

Part 1: Black Box Investigations:

1. **Introduce the Black Box**

Challenge. Holdup a black box. Shake it gently and tell the students that there is something inside, but you don't know what, and you can't look because the box can't be opened. Remind students to be vary careful when handle boxes because of the wooden pointed rods sticking out. Their challenge will be to figure out **what the box looks like inside** and what might be **attached** to the rods.

2. **Form Teams of Four**: Have the students work in pairs of two. One student will be the **STARTED** the other, the **RECORDER**. Each team will investigate one box. Instruct the students to take turns with the box so everyone has a chance to participate in the investigation.

3. **Give the Rules**: To prevent damage to the boxes, explain the rules of investigation to the students.

* The boxes remain closed (unless instructed by the teacher to see what would happen if you removed one of the rods from the box).

* No drawing on the boxes.

* No violent shaking or hard pressing----boxes can break along with rods.

Assign Boxes: Have one person from each group appointed to pick up boxes labeled A and B.

Have the **STARTERS** go to the materials station to get a box with their assigned letter. Let the teams start to figure out what the box looks like inside and what might if anything attached to the rods. Tell students that after you have done all the experiments you can think of. (*with out pulling out the rods)* try to imagine in a general way what is inside the box that could account for their observations. This will be the model for the box. Do not be distracted by details. Do not, for example, try to name the objects inside the box; only describe them by the properties that you have found in your other experiments. If you hear something sliding on one of the rods; you could easily describe it as a washer or a ring or lead weight for a fishing line; but the important point is that it is something with a hole in it through which the rod passes.

Tell students that after you have made models that account for your observations, predict what will happen as you pull out a particular rod. Also predict how this will affect the results of the tests you performed earlier. Then you or one of your group members can remove a rod from only one of the boxes. Pulling out one of the rods may change things enough to prevent your checking your prediction of what would have happened had you pulled out another rod first. If what happens confirms you predictions, you can use one of the other boxes to test your predictions about what would happened if you had pulled out one of the other rods first.

5. Identify the Marble: After two or three minutes, ask the students what they have discovered. When someone suggests that there is a marble in the box (or may be a washer or a ring or even a lead fishing weight). Ask for a show hands from those who agree. Confirm that each box has a marble.

Encourage the students to concentrate on the LOCATIONS and SHAPES of things in the boxes. Suggest to the students that **drawing pictures or diagrams** might help them figure out what's inside the boxes.

6. **Explain Drawing Box Contents.** After the students have been working 10 to 15 minutes, call for attention and explain that the RECORDER from each group will come to the board and draw what their box looks like inside.

7. **Introduce Model.** When drawings are on the board, tell the students that the pictures they have drawn are MODELS of Black Boxes.

Explain to the class that people make MODELS of things that are very big, like the solar system, things that are very small, like atoms, and things that are impossible to into, like black boxes. *a MODEL is a REPRESENTATION OR EXPLANATION OF something that shows how it looks or works.*

8. **Discuss the making of the Models.** Ask the students what senses they used to explore the boxes. Ask them to demonstrate the techniques they used to investigate the boxes.

9. **Work Toward Consensus.** Tell the students that *CONSENSUS MEANS EVERYONE AGREES.* The groups should try to reach consensus on the best model for their boxes through discussion, observation, testing of ideas, and carefully applied techniques. Then have a Recorder form each group come up to the board and draw the consensus model on the board.

10. Discuss the Final Models. The students may want to open the boxes. Explain to them.

> *There are many things in world like* ***BLACK BOXES*** *that can't be opened-the center of the earth, atoms, the sun, etc. We try to understand what they look like and how they work by getting as much information as we can. When we get new information, we change our models to include the new knowledge. Models always represent our best explanation of how things look or work, and models can always change.*

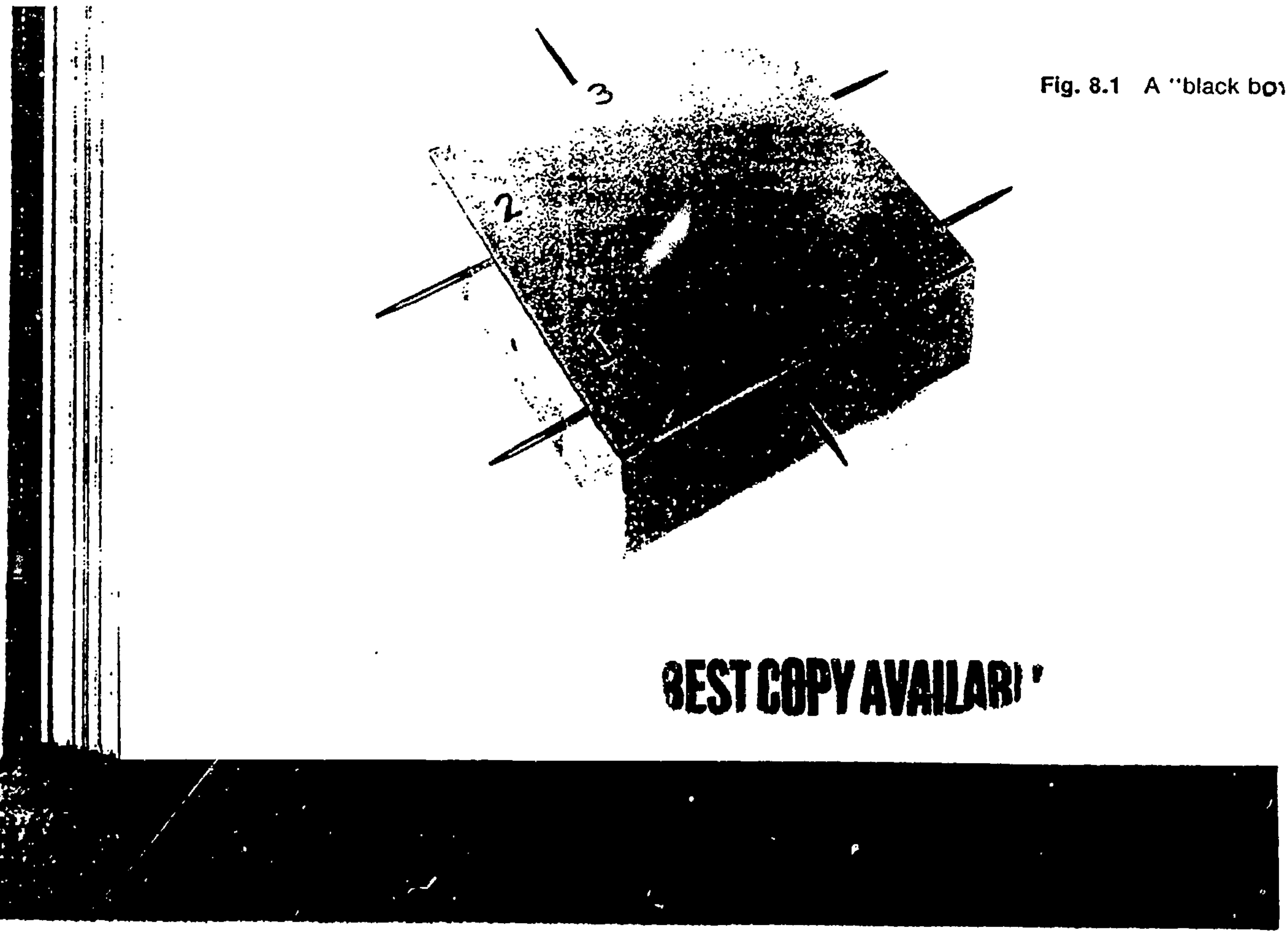

Fig. 8.1 A "black bo

BLACK BOX ACTIVITY
A PROJECT IN INFERRING

BY

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BACKGROUND FOR TEACHER

In science we often seek answers for which we can not really "know" when we have the rig't answers. Just as we can not explore the interior of the earth, we build our knowledge of what's inside by the collecting of data that allows us to draw conclusions of what probably constitutes the interior. By measuring seismic waves from an earthquake's released energy that had been stored, we can compare the two types of waves. P-waves are compressional waves. As P-waves travel through matter, the matter is alternately compressed and expanded much as sound waves travel through air. By using a Slinky (registered trademark) stretched to 10 feet or so along a smooth surface, hold one end in place and push in the other end suddenly then holding it still a compressional wave can be demonstrated. S-wa. ; are shear waves with a side-to-side motion. Using the same Slinky, stretch out as before, this time pull out on the side causing the loops to move sideways related to each other not closer as with the P-waves. The use of seisographs allows us to measure ground motion caused by these waves. P-waves travel faster through rock than do S-waves. We are then able to surmise what the earth's interior is composed of. By using this type of thinking with the collection of data, we can begin to construct the BLACK BOX INTERIORS.

All of Science is a black box. We seldom are able to demonstrate the reality of ideas in a physical manner. We can only infer. This is an activity in inferring.

PURPOSE

In black boxes the students will:

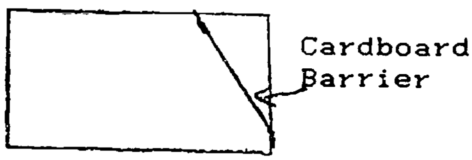
1. investigate and observe a black box
2. predict what the inside of the box looks like
3. gather and organize data
4. draw conclusions

OVERVIEW

In this activity students play with black boxes to discover what the interior is like based upon the behavior of the object inside the black box and its interaction with the interior. After drawing the physical interior of a black box students will exchange their black box with other groups and draw that black box. This box interchange will continue until each group has had access to and drawn th interior of each of the 6 black boxes. Based upon what they think happens when the box is moved, they are to come to consensus, in their group, as to the shape of the interior of the black box.

GETTING READY

1. Build black boxes. Take 6 boxes, all the same dimensions. Use a marble for each interior. Make a change in each box using cardboard and tape (I am going to try hot glue and cardboard next time) so the marble does not roll true to each corner. Example:



Cover boxes with black paper.

2. Run off sheets for copying the interior for each group. Run off individual sheets.

FOR EACH GROUP OF 4 STUDENTS

1 - Black box with number on the top

1 - Pencil

1 - Student sheet per black box

1 - Group sheet

FOR THE CLASS

6 - Black boxes

1 - Master of group inference sheet

VOCABULARY DEVELOPMENT

Inference : Logical conclussions based upon reasoning - decisions based upon observations.

Waves : One of the periodic vibratory impulses produced by a disturbance in and propagated through an elastic medium.

Prediction : An assertion based on data.

REFLECTING ON THE ACTIVITY

1. Were all the boxes the same?
2. What helped you form ideas on what the box looked like inside?
3. Can you think of something else we can't see but use the BLACK BOX method to figure it out? (example - Gravity)
4. What job would require you to make a lot of inferences?

DOING

1. Form groups at each lab station. 4 per group for a total of 6 groups.
2. Introduce the activity by explaining the process of inferring. Do the worksheet from the Focus On Life Science series by the Charles E. Merrill Publishing Co., Columbus, Ohio 1984
3. Distribute boxes and individual sheets and group sheets. Explain each group must come to consensus and submit only 1 drawing per box on the group sheet.
4. Record individual inferences of the boxes interiors and then proceed to work on 1 concept or drawing of the box for the group worksheet.
5. Exchange boxes and repeat #4 until all boxes have been seen by all groups.
6. Compare and graph on an overhead the results of each box. Was consensus reached - How many groups agreed?
7. Clean-up

Please draw what your group agrees is the interior of the box.

Box 1

Box 2

Box 3

Box 4

Box 5

Box 6

Group Sheet

	BOX 1	BOX 2	BOX 3	BOX 4	BOX 5	BOX 6
GROUPS IN AGREEMENT						

Name ______________________ Date__________ Class______________

Part B

Sometimes you make decisions that are based on your observations. Such decisions are called inferences. Inferences are logical conclusions based on reasoning.

Look at the diagrams below. Read the statements. Based on what you observe, decide if each statement is an observation or an inference. Write observation or inference on the line to the left of each statement.

FIGURE 2-2

______________ 1. The plant has roots.

______________ 2. The plant uses water.

______________ 3. The plant has leaves.

______________ 4. The plant has flowers.

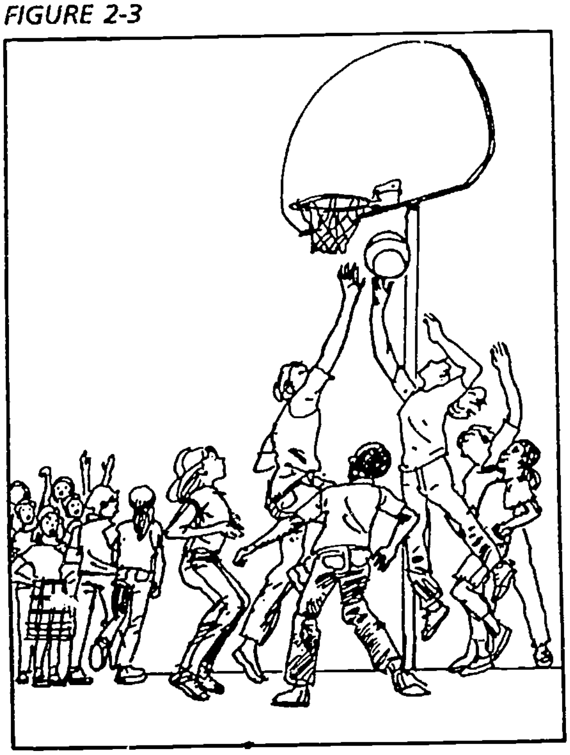
______________ 5. The plant grew from a seed.

______________ 6. The plant is growing in soil.

______________ 7. The plant is green.

______________ 8. The plant is growing in a pot.

FIGURE 2-3



______________ 9. Young people are playing basketball.

______________ 10. The players are in seventh grade.

______________ 11. People are watching the game.

______________ 12. The score is tied.

______________ 13. The game is almost over.

______________ 14. The people are outdoors.

______________ 15. There are six players.

BLACK BOX CREATING YOUR OWN CONSTELLATIONS

BY

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Strand

Scientific Reasoning and observation

Scientific Concepts

Black Box Puzzle

Scientific Thinking and Process

Observe
Communicate
Organizing
Relating

Interdisciplinary Activities

English
Art

Purpose

To show how the constellations came into being

With star dots the students will;

1. Observe dot locations

2. Visualize constellations and create their own constellations.

3. Create myths for constellations.

4. Communicate their stories to the rest of the class

5. Draw a picture with in the framework of the constellations as an art addition to the science class.

6. After presentations students will draw with red pencil the northern constellations over their own constellations. These will be the constellations

normally present in the Northern Hemisphere for the current month. The students will then compare their visualization to the ancient Greek view of the stars and the constellations.

Procedure

Make a map of dots from a star map of the northern hemisphere. Use carbon paper between the star map and the paper. After finishing the marking of the star dots go over the dots with number 2 pencil to insure they will copy easily on the duplicator.

Before the map of dots is passed out, students will learn about the constellations and myths that surround them. Students will also view films on constellations and the universe along with viewing the star chart of the northern constellations.

Students then will be required to draw their own constellations at they see them on the map of dots. Students can look for patterns and draw from one to three constellations. All constellations drawn must be included in the myth.

Students will make presentations to the class on their constellations and myths.

After the presentations students will look up constellations in the Northern Hemisphere and mark them in red on their star maps and then compare their constellations with the real constellations.

Students are graded on their presentations, the constellations, art work and the myth that accompanies their constellations.

Materials Needed for each student

1 set of dotted star charts
1 Red pencil/Pen for drawing in the actual constellations
1 regular pencil
1 text and the included star chart of the Northern Constellations

END

NJS505B.WPS

BLACK BOX SHADOWS

BY

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BLACK BOX
SHADOWS
GRADE 7

SCIENCE CONCEPTS:
LIGHT AND SHADOW

SCIENCE THINKING PROCESS:
OBSERVING AND INFERRING
COMPARING AND CONTRASTING

PURPOSE:
USE THE STUDENTS SENSE OF SIGHT TO OBSERVE AND INFER

OVERVIEW:
STUDENTS WILL BE SHOWN A BALL SUSPENDED FROM A STRING IN FRONT OF A PROJECTOR LIGHT. THE SHADOW WILL BE PROJECTED ON THE SCREEN .

MATERIALS :
PROJECTOR
SMALL FLASH LIGHT
BALLS ON STRING - BASKETBALL, PING -PONG BALL
CUT OUT OF A CLOWN
TWO PIECES OF CARDBOARD 3X3" AND 6X6"
PINS WITH ROUND PLASTIC HEADS. WHITE PAPER WITH A PENCILED CIRCLE 10 INCHES IN DIAMETER IN THE CENTER.

DO AND DISCOVER:
HOW ARE SHADOWS FORMED ?
1. COVER THE LENS OF A PROJECTOR WITH A DISK THAT HAS A SMALL HOLE IN IT . SHINE THE BEAM OF LIGHT THROUGH THE DISK. SHINE THE BEAM OF LIGHT AT A SCREEN ABOUT FOUR FEET AWAY,. HANG A BASKETBALL FROM A STRING IN THE PATH OF THE LIGHT. OBSERVE THE SHADOW THAT FORMS. REPEAT, MOVING THE PROJECTOR EIGHT FEET FROM THE SCREEN AND OBSERVE.
2. REPEAT WITHOUT THE DISK AND OBSERVE.
3. REPEAT THE EXPERIMENTS USING THE FOLLOWING OBJECTS CTS TO BLOCK THE LIGHT: A BASEBALL, A PING-PONG BALL; TWO SQUARE CARDBOARDS (3X3" AND 6X6") , AND A CUTOUT OF A CLOWN. OBSERVE THE SHAPES AND SIZES OF THE SHADOWS. ARE THEY RIGHT-SIDE UP?

QUESTIONS:
WHICH LIGHT MAKES A SINGLE SHARP SHADOW?
WHAT CAUSES TWO SHADOWS TO FORM ? IS THERE ANY DIFFERENCE IN THE SHARPNESS OR DARKNESS OF THE SHADOWS?
WHAT MAKES THE SHADOWS LARGER OR SMALLER ?
HOW CAN YOU TELL IF THE SHADOWS ARE RIGHT-SIDE UP?

A CIRCLE OF EIGHT LARGE PLASTIC HEADED PINS NEEDS TO BE PLACED AT EQUAL INTERVALS AROUND A 10 " PENCIL DRAWN CIRCLE. THE MODEL SHOULD BE PLACED IN A LIGHT OR THE SUN LIGHT TO FORM SHADOWS . TRY THE FOLLOWING:
1. SEE IF YOU CAN GET ALL THE SHADOWS OF THE PINS TO POINT IN THE SAME DIRECTION.
2. HOW CAN YOU GET ALL THE SHADOWS OF THE PINS TO POINT OUTWARD-AWAY FROM THE CENTER OF THE CIRCLE?
3. HOW CAN YOU GET ONLY ONE SHADOW TO LIE INSIDE THE CIRCLE?

ANSWERS THE STUDENTS MIGHT DISCOVER FROM THEIR OBSERVATIONS:
1. THE STUDENTS WOULD HAVE TO EXPERIMENT WITH A PARALLEL BEAM OF LIGHT SUCH AS A SPOT LIGHT OR USE SUNLIGHT.
2. A SMALL LIGHT WOULD HAVE TO BE PLACED IN THE CENTER OF THE CIRCLE.
3. A SMALL LIGHT WOULD HAVE TO BE PLACED OUTSIDE THE CIRCLE BEHIND ONE PIN.

LANGUAGE DEVELOPMENT:
LOOK FOR OTHER SHADOWS IN THE STUDENTS' LIVES. EXAMPLE: HOLES IN SHADOWS, COLORED SHADOWS, AND CRAZY SHADOWS.

BLACK BOX ACTIVITY
ELECTRICAL CIRCUITS

BY

MYRON KANIKKEBERG
KADENA MIDDLE SCHOOL

BLACK BOX ACTIVITY
ELECTRICAL CIRCUITS

PURPOSE

In this activity the students. will:

Learn what an electrical circuit is.

Learn that electricity travels in paths.

Build a device to test electrical circuits.

Discover the pattern of an electrical circuit and draw it.

OVERVIEW

In this activity students will use the testing device they build to determine what the path of electricity is on various circuit boards. They will not be able to see the circuits therefore they will need to discover the path the electricity takes by using two probes connected to a dry cell and a light bulb to determine which points the electricity can travel between. There will be six holes on each card and the students will discover and draw the path between them that the electricity flows . There will not be a connection between some of the points. The students drawings will be made on a separate piece of paper. Each group of students will test 7 cards. This can be done as a lab activity in small groups, or it can be used as a center in the classroom ,for a unit on electricity.

MATERIALS

1 circuit board per team

one dry cell, size D

one dry cell holder, size D

one light assembly

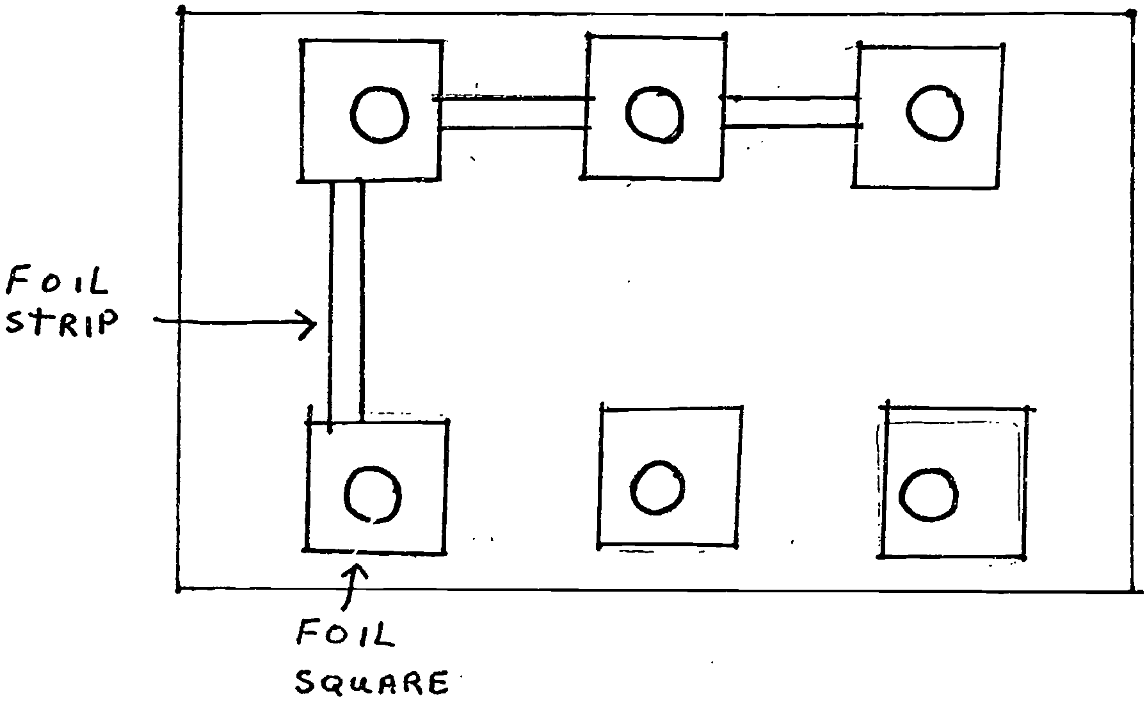
3 , 6 inch lengths of electrical wire.

1 answer card for each circuit board tested.

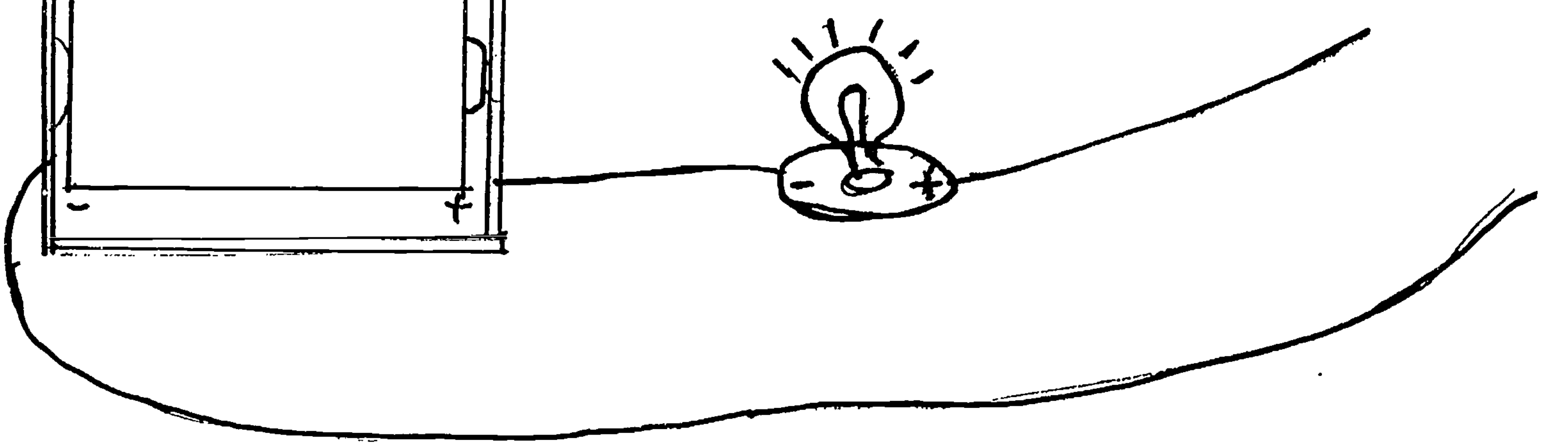
GETTING READY

Prepare the circuit boards. Punch 6 holes, 3on each side of the 5x7 card with a three hole punch. The holes on each side should be equal distance apart. Then glue 2cm squares on the tab board where the holes on the 5x7 would be. Glue strips of foil between the some of the squares of foil to make an path for the electricity to flow. Then put the card with holes over the circuit board so the holes line up over the squares of foil. tape the cards together along the edge using masking tape or electrical tape, making sure not to cover the holes punched in the card. Make at least 7 different patterns/electrical circuits. Code each card with a number and make a drawing of that pattern on a separate card to show where the foil is because these strips will be covered with the 5x7 card with the holes punched in it. See the attached diagram.

circuit board example



circuit tester



DOING THE ACTIVITY

1. The students are in groups of four at lab tables. They have four different roles. leader, materials/clean up, data recorder and measurement taker.

2. Introduce the activity and teach what a simple circuit is.

3. Show the students how to assemble the circuit tester and test each circuit by touching the ends of the wire to two points on the circuit board where the holes are punched.

4. Test all points on the circuit board to determine the paths where electricity could flow.

5. Draw the circuit as you think it looks on a piece of paper.

6. Continue this process until you have tested and drawn 7 different circuit boards. Share circuit boards with other groups.

7. Make sure each student gets an opportunity to test a circuit board and draw the pattern the electricity could follow.

REFLECTING ON THE ACTIVITY

The students will summarize the activity by checking the patterns they have drawn and comparing them with the teacher prepared answer cards.

The students will identify errors on their drawings.

They will explain why this method of testing circuits works.

BLACK BOXES GRADES 6-9

BY

JAMES F. WEAVER
KADENA MIDDLE SCHOOL

BLACKBOXES GRADES 6-9

OVERVIEW

Blackboxes is an exercise in inductive reasoning. The scientific method is a problem solving process based on inductive reasoning. Reasoning by induction occurs when many facts are brought together to produce a general concept. The many variations of the blackbox allow students to question, probe, measure, feel, and use many other techniques to discover the contents of the blackbox. The following activity is another form of this mode of thinking.

PURPOSE

Students will be expected to

- Gain experience with the concept of blackbox.
- Gain experience with questioning as a means of problem solving.
- Synthesize many facts to form an idea of the contents of the blackbox.

MATERIALS

- WOODEN MICROSCOPE BOX, PAINTED BLACK.
- OBJECT INSIDE BOX WHICH CAN BE CHANGED AT THE END OF THE ACTIVITY.
- STUDENTS NEED PAPER TO TAKE NOTES AND WRITE DOWN THOUGHTS.

DOING THE ACTIVITY

This activity is designed to be a class group activity with every student participating and the teacher being the responder to questions.

This blackbox is a variation of "20 questions". The number of questions to be allowed will be two per student or double the number of students in the class. If a student chooses not to use both questions, other students may use them as long as the maximum is not exceeded. Questions must be in yes or no answer form. The teacher will answer questions until the maximum has been reached. Students are to write down what they think is in the box when they have an idea, no one is to shout out ideas until all questions have been asked.

After all questions have been asked the contents of the box can be revealed. I suggest a small prize be given to any student with the correct contents of the box written down.

REFLECTING ON THE ACTIVITY

Students that by mistake ask a question that is not answerable with a yes or no will lose that question. If a student gives away the contents to the class, the box can be refilled and that student will be exempt from the resumed activity.

This activity was conducted in an eighth grade science classroom with a football as the contents of the box. It was discovered that most students had no clue until someone asked a very revealing question. At this point, the questions became more focused productive. 24 students were in this particular class and after 48 questions, most concluded that a football was indeed contained inside the box. A reward of a "jolly-rancher" was given to each student with the correct answer.

The black microscope box idea could be used in a variety of ways. One idea is to have students in small groups feel, shake, weigh, or probe in many ways short of opening the box. The object would be for the group to develop a concept of the contents and draw a picture of the contents to share with the entire class. Ideas from other groups could then be compared.

WAYS OF KNOWING
ACTIVITY 2
THE BLACK BOX

BY

TIMOTHY J. CONNORS
KINNICK HIGH SCHOOL

by Timothy J. Connors
Kinnick High School

BLACK BOX EXPERIMENT **ACTIVITY - 2**

PURPOSE

In this investigation the students will

* Investigate a "Black Box".
* Be able to work together in cooperative groups to discover how a "Black Box" works.
* Determine the various alternatives to the workings of the "Black Box".
* Provide various alternatives to the workings of the "Black Box".
* Gain experience working as a cooperative group to solve problems.

OVERVIEW

In this investigation students will be given a problem to solve known as a "Black Box." In order to solve the problem, the students will be assigned to cooperative groups and will work within that group to solve the problem: "How does this "Black Box" work? The "Black Box" consists of a sake dispenser which resembles a ceramic teapot. The sake dispenser will only pour as much liquid as a small sake cup will hold. However, each time liquid is poured from the sake dispenser, the same measured amount is obtained in each small sake cup. The students problem is to explain how this works. Students will be asked to come up with a diagram to explain the phenomenon.

BACKGROUND FOR THE TEACHER

Students always seem to be excited when given a problem to solve. It enables them to see things that look strange and mysterious while at the same time presenting a challenge to them that they can solve. In this activity the students will be observing a "Black Box" in an Asian manner of thinking. The students will be able to work together in cooperative groups to discover how the sake dispenser works. The students will be asked to devise a diagram showing the internal structure of the sake dispenser and then they will explain their thinking to the class. They should discover that there will be a variety of possible solutions to their problem, but only one answer will be correct in terms of this particular "Black Box." As a further investigation of this type of problem, perhaps students could devise and/or construct their own "Black Box."

The students will enjoy searching for solutions to this problem. To make sure that each student meets with success, it will be important to have students work in cooperative groups. Working alone, students may have a difficult time coming up with possible solutions. However, working together in groups should make the task less stressful for some. The sake dispenser used was obtained in Okinawa where it is a common article. There is also a ceramic cup that is a "Black Box." When the cup is filled to full, the liquid escapes through a hole in the bottom. If there is less liquid in the cup, no overflow occurs. The purpose of the cup is to prevent someone from becoming too greedy and taking too much sake. Those who drink in moderation will not end up with sake on their body. Those who take too much sake will end up with most of it on their clothes. Have plenty of paper, markers, and pencils available for students to use as they consult with one another and devise possible solutions.

MATERIALS

For each group of four students
- drawing paper or poster paper
- colored markers
- pencils

For the class:
- Black Boxes, e.g. sake dispensers (see figure below):

GETTING READY

1. **Schedule the Activity.** This activity is in one part. You may find that it takes fifteen to thirty minutes to complete this and additional sessions for the extensions.

2. **Purchase or construct the "Black Box".** collect or construct a variety of "Black Boxes".

3. **Gather materials.** Have the necessary poster paper, markers and pencils available.

STUDENT SHEETS

1. **Data Sheets.** No special data sheets are required. Students may record their answers and drawings on their paper and/or posters.

DOING THE ACTIVITY

PART ONE: Observing the "Black Box>"

1. **Form Collaborative groups.** Organize your class into cooperative groups of four. Discuss the four jobs within the groups: GETTER, STARTER, READER/REPORTER, RECORDER. Tell them that each group will present their results at the conclusion of the study.

2. **Introduce the Activity.** Inform the students that they will be starting a new science activity today. They will be asked to view an Okinawan Sake Dispenser to determine how it works. they will be asked to demonstrate their expertise in solving the problem by drawing a detailed sketch indicating how the sake dispenser works. They will also be given the opportunity to report to the class on their findings.

3. **Distribute Materials.** Have the GETTER from each group to come to the materials station to get materials for the teams. (Paper, markers and poster paper can be placed on tables prior to class.)

4. **Demonstration.** Demonstrate to the class how the sake dispenser works by first filling the sake dispenser and then pouring sake into the small sake cups. Do this several times so that everyone can see the problem.

5. **Introduce the concept of a "Black Box."** Introduce the concept of "Black Boxes" to the class by showing pictures or illustrations of other types of "Black Boxes" that they may encounter during the activity. If possible use actual samples of other "Black Boxes" which students may work on after they complete this project.

6. **Challenge.** Present the challenge to the students: *How does the sake dispensers work? Discuss in your group the possible solution for how the sake dispenser is able to dispense the same amount of sake each time even though there is still sake in the dispenser?* Ask the students to diagram their answer and be able to present their findings orally to the class.

7. **Drawings.** Have the students draw and color their solutions for the problem. Have the students label their drawings.

8. **Discussion & Conclusion.** Have the teams meet to discuss their drawings to make a list of the possible solutions to the problem. On a large sheet of paper have students make drawings illustrating the various ways the "Black Box" work. Each team should present their findings to the class for discussion. After all discussions and presentations have taken place, have the students vote on the one idea or concept that they think is the best. Then explain to the

students how the sake dispenser works!

REFLECTING ON THE ACTIVITY

1. What methods were used by various groups to solve the problem? How did different groups attach the challenge?

2. Were other methods devised to solve the problem that would also work? Perhaps as an extension these students could construct a "Black Box" using their own criteria.

3. What are some "Black Boxes" that students come across in their daily lives?

4. Based on your findings, could you construct a different type of Black Box"?

VOCABULARY DEVELOPMENT

Black Box: a mysterious devise which defies logic on first examination.

LANGUAGE DEVELOPMENT

1. **Teach Peers.** Have one or more students demonstrate to other students how a "Black Box" works. Students could work in pairs to explain the concept to others.

2. **Make a "Black Box" Bulletin Board.** Have students make a display poster for the bulletin board that shows various types of "Black Boxes." The poster should include:
   * a title
   * a definition of a "Black Box"
   * pictures or drawings of various "Black Boxes"
   * a question for readers to think about, such as "How do these objects work?"

MATHEMATICS DEVELOPMENT

1. **Organize the portions of sake.** Have the students make a chart of the amount of sake that is dispensed from the sake dispenser. The students could measure in milliliter (mL). The chart may look like this:

Amount of Sake (mL)	Trial Number
15.0 mL	1
14.5 mL	2
14.0 mL	3
etc.	

EXTENSIONS AND APPLICATIONS

1. **Compare other types of "Black Boxes."** Have students do the same activity, but substitute different types of "Black

Boxes" and make a list of similarities and differences.

2. **Construct "Black Boxes."** Have students design and construct their own "Black Boxes". The students could then exchange their "Black Boxes" and have other students try to determine how they work.

BLACK BOX EXPERIMENT

BY

DAVID D. HUFFMYER
ZAMA HIGH SCHOOL

BLACK BOX EXPERIMENT
Science Course III
Mr. Huffmyer
Zama High School

Purpose: To explore the properties of magnetism in a "black box" experiment.

Objectives: (1) Find the location of some unknown magnets using a compass as a tool. The students will be able to discover magnetic fields by exploring an unknown location with a compass, a piece of paper, and a pencil. (2) The students will use compass skills much like those used in orienteering.

Materials: Per group of students

A table stand

A piece of cardboard

Sheets of drawing paper

4 magnetic marbles

4 compasses

1 petri dish with iron filings (extension)

Pencils

Getting ready:

1. Prepare the activity boards; stands, cardboard, drawing paper and magnetic marbles.

Time: 1 30-minute session for the activity. Variations can extend the time involved.

2. Prepare the exploration. Have materials at each station so students can rotate through 2-3 different activities and make predictions about the arrangement of the magnetic marbles.

Doing the Activity:

(1) Review the properties of magnetism and like - unlike poles

(2) Have students move a compass over magnetized spheres and notice the needle deflection when the compass is directly over the sphere.

(3) Some of the students in a group will arrange their "black boxes" by setting up a stand (see figure) and positioning magnetic marbles under the stand.

(4) The remaining students will be doing the activity as they position compasses over the stand and discover the location of the pre-positioned magnetic marbles. The students will need to use compass skills, as well as, the indicators they learned in step 2. They will record their results in step 5.

(5) Each magnetic marble will be located and marked on a blank sheet of xerox paper and the students will move on to the location of the next one. When the students have made their predictions about the locations they can move on to the next station. The actual position of the marbles will remain unknown as student develop confidence in their ideas and ability to

reason.

(6) A closing discussion about the experiment and the methods of discovery include technique and ideas.

Extentions

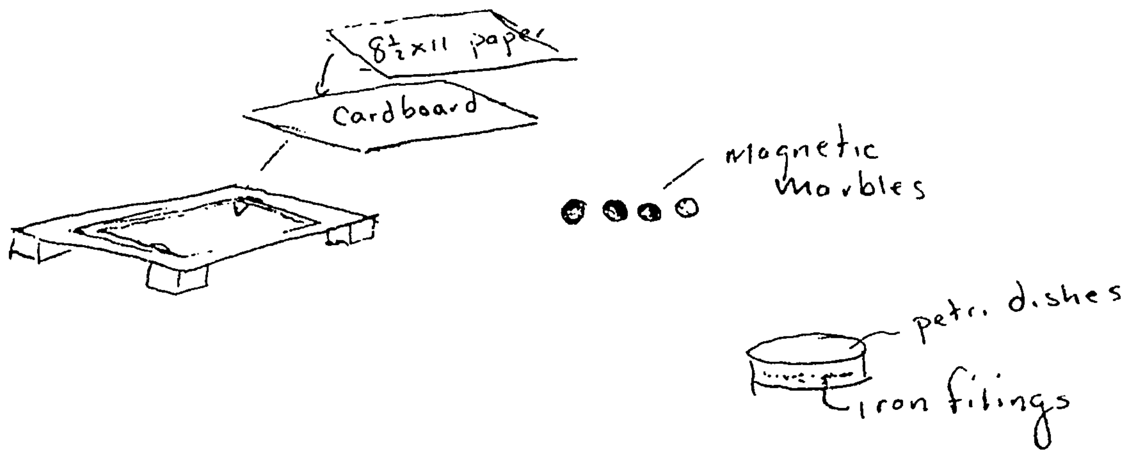
(1) A larger experiment can involve tracing magnetic objects under the stand using petri dishes with iron filings.

(2) Unknown magnetic shapes can be located and traced using a table and a petri dish containing iron filings. The shapes are placed under the table so that the students must use the indication of magnetic fields as the dish is passed over the objects.

(3) The tracing is then done on the drawing paper and a hypothesis can be made on the shape and location.

(4) The results can be examined by the student to asses the degree of success.

Drawings:



Reflecting on the Activity:

(1) Discuss the unknowns involved in this activity.

(2) Think of some systems that are not fully understood like "black boxes".

(3) How are some of the methods used to reason through a "black box activity like trying to discover how a video game works or how a shape is made up of smaller puzzle shapes.

THE HANDS DOWN METHOD OF RANDOM SAMPLING OF ICEBERGS FOR POLAR BEARS AND ICE HOLES A BLACK BOX ACTIVITY

BY

MARY BAKER
KINNICK HIGH SCHOOL

THE HANDS DOWN METHOD OF RANDOM SAMPLING OF ICEBERGS
FOR POLAR BEARS AND ICE HOLES
A Black Box Activity

Strand: Scientific reasoning and technology

Science Concepts: Sampling techniques, discovering patterns, estimating, critical thinking, problem solving, collaboration

Science Thinking Processes: Observing, communicating, comparing, organizing, and relating

Interdisciplinary Activities: Language and math

PURPOSE: Students will make observations, develop and test patterns, and communicate ideas thereby building on an idea with group effort and cooperation.

OVERVIEW: In this activity, students in groups of four, will discuss the term "random sampling" and decide on a definition. Students will identify the need for such a sample in nature. The small groups will then come together in a single group setting to practice a random sampling activity. The purpose is to demonstrate how scientists may determine how many polar bears congregate at ice holes on icebergs and in the process they will use a wide variety of concepts.

BACKGROUND FOR THE TEACHER: This activity represents an unknown that is completely visible, yet until the pattern is broken, it may seem completely incomprehensible. Individual ideas grow and change as they are tried by group members, thus the notion that ideas evolve more quickly within group collaboration is demonstrated. Once a pattern is determined, every member can participate and feel successful in solving what at first seemed a very difficult task. With cooperation, the problem becomes a simple case of observation and addition and hopefully will encourage students to strive to work together and have a good attitude and thinking and problem solving.

MATERIALS: about five dice

GETTING READY:

1. Schedule the activity. This activity started out as a 10 minute sponge activity for the beginning or the end of class on 2-3 consecutive days or when convenient, but has evolved into and may be used as three 30 to 45 minute lessons depending on the number of rounds and how many concepts are used and stressed. The activity does not have to be conducted on consecutive days. Some students will ask questions about ideas that have been going through their minds about the activity thereby increasing the amount of thinking that is going into the activity.

2. The room setting should be such that groups of four can be utilized and then the entire group can come together so that they may all see the dice and work toward a solution. If the class is large, have an inner seated circle, and a standing outer circle.

DOING THE ACTIVITY:

PART 1: Introduce the term "random sample" to the class. Encourage the students to define and discuss the term and its uses in groups of four. Ask the students how random samples may be used in various scientific (example: determining numbers of endangered animals in a large park) and in other situations (example: Which drink do more people prefer, Pepsi or Coke?).

2. Bring the class together as one large group. Set up the scenario of a pilot/zoologist hired to randomly sample polar

bears and ice holes on icebergs in an area of the Arctic ocean. The pilot has only enough gas to cover 1/10 of the area.

3. The teacher should be kneeling (sitting on heels) on the floor with his/her fingers spread out on the floor as the last few instructions are given or questions elicited. The five (or so) dice should be beside the teacher. Instruct the students to observe carefully and be sure not to talk out. Choose any number of the dice and roll them out into the circle so that everyone in the group may see.

Example: ice holes -2  polar bears - 4

polar bears -2

icebergs -6  

4. As the teacher brings his/her hands back to the floor in front of him/her, rest the fingers on the floor to form a number 0-10 in a very casual manner. Look around the group and question 1 or 2 students about how many icebergs they count. They will most likely respond to the number of dice that were thrown. Praise correct responses and casually correct incorrect responses. Next question various students about the number of bears and ice holes. (Reminder to the teacher: the dot in the center is an ice hole and any other dots are polar bears). Play up the answers and ask the group for agreement, then very clearly give correct responses. Mark down the numbers for each iceberg, polar bear, and ice hole on the board.

Example:   icebergs polar bears ice holes

5. Go through the arrangement a total of ten times. Look for

signs of frustration and remind the students that it takes time and careful observations to notice patterns. Praise ideas that show that thinking skills are being used even if they are totally wrong.

6. Discuss how the data should be used to make an estimation of the number of icebergs, polar bears, and ice holes there are in the area if only 10 percent was sampled.

7. Close part one of the activity by discussing the purpose of the activity and recalling any signs of a consistent pattern.

PART 2:

1. Follow the same procedure as in part one, but for these rounds, stress that name of the activity. Make the announcement several times that this is the "**hands down** method of random sampling".

2. Stress the sharing of ideas and praise attempts to use thinking skills.

3. Make sure that everyone is "in on" the hands down part of the activity before ending the rounds. Encourage students to discuss their individual feelings about information they shared with the group in an attempt to solve the problem that turned out to be "wrong". Get the students to realize that "wrong" ideas are beneficial. Encourage the students to be confident in sharing ideas and discuss the benefits of keeping an open mind when problem solving so that good ideas are not tossed out too quickly and to reduce the amount of the time spent going down "the wrong road."

4. Discuss the results of the estimation for the rounds today as

compared to part one and close the activity..

PART 3:

1. By this session, students have usually discovered the pattern of determining the number of icebergs. They are feeling successful and will continue to think about the pattern that will reveal the number of polar bears and ice holes.

2. Stress that the bears are **around** the holes. Encourage the sharing of ideas and test the idea on each round.

3. After the tenth round, study the data taken each day. Discuss the estimation of icebergs, polar bears and ice holes figured for each day. Discuss the validity of a random sample based on the findings in this activity. Compare and contrast a real random sample to the activity done in class.

4. Encourage student to reveal how the activity would have been different if they had not been able to share their ideas with the group or been able to build on the idea of others in the group.

5. Close the activity by encouraging students to work together and discuss how the polar bear activity relates to problems in real life.

REFLECTING ON THE ACTIVITY:

1. Explain a random sample and the value of estimating in everyday life.

2. Develop a pattern of your own to try on the class using dice or another manipulative or idea.

3. Relate this activity to patterns and problems that occur in everyday life.

4. How do individuals feel when problems seem too difficult to

solve? What can students do to avoid defeat when a problem seems too frustrating to continue attempting to solve?

VOCABULARY DEVELOPMENT:

black box: a system that cannot be seen into or understood easily.

random sample: a representative sample drawn from a population so that an estimation of total numbers can be deduced

*Be certain your students understand the meaning and are able to use effectively the following terms:

estimation   pattern   congregate   endangered   zoologist

LANGUAGE DEVELOPMENT:

1. Black Boxes

Students will be encouraged to look for black boxes in daily life. Topics may be suggested, such as black boxes in medicine might be a cure for AIDS and cancer. The ideas will be continually reviewed and discussed.

2. Frustration

Students will identify how black boxes may present a positive solution to difficult situations in a students personal life. Students often become overwhelmed to the point of giving up. Communicate in some way (drawings, letters, group discussion) how this common problem can be avoided or reduced.

SCIENCE AND MATH DEVELOPMENT:

1. Students will continually use estimation in class and be encouraged to make predictions about possible outcomes based on research and experimentation.

2. Provide time for students to research important scientific discoveries that were seemingly simple ideas, but have large complex concepts. Also point out that seemingly impossible problems are sometimes discovered, identified, and solved discovered accidentally. Examples could be Newton's discovery of gravity that lead to many other ideas, the discovery of penicillin, or principles that allow man to fly. Also provide opportunity for students to discover that ideas build on the ideas and work of others. It is important for students to see that by working as a group, many more ideas will be used and progress will be increased that when individuals are working and making minor discoveries on their own.

FOSS (FULL OPTION SCIENCE SYSTEM) FOR ALL STUDENTS:

VISUALLY IMPAIRED. Be sure to announce the number and arrangement on the dice.

HEARING IMPAIRED. Refer to numbers for each round listed on the board.

ESL or Learning impaired students maybe let in on a part of the secret prior to the activity to build self confidence and to help them become part of the group effort.

ACTIVITY OUTLINE:

1. Announce clearly the name of activity.
2. Introduce the situation.
2. Discuss the terms that will be used in the activity.
3. Form small groups then a large group and discuss rules.
4. Complete the first round and record the data.
5. Proceed through 9 rounds.

6. Help students avoid frustration.

7. Provide encouragement and assure students that there is an obtainable solution to this particular problem.

6. Discuss estimation and how it can be used with the data.

7. Discuss how the activity relates to life situations.

PART 2:

8. Follow that same procedure as in part one.

9. For these rounds, stress the name of the activity. Make the announcement several times that this is the **"hands down** method of random sampling".

10. Stress the sharing of ideas and praise attempts to use thinking skills.

11. Be sure that everyone feels successful before the end of the lesson if most students have figured out the icebergs.

PART 3:

12. Stress the fact that more ideas are available if students share with the group.

13. Stress the idea that "polar bears are almost always spotted **around** ice holes".

14. Make sure everyone feels successful.

15. Do a few rounds after the secrets are revealed.

16. Compare and contrast the estimation part of the activity.

17. Encourage students to create or share their own "polar bears" (black boxes).

18. Close the Activity.

BLACK BOX M ATERIALS IDENTIFICATION

BY

DAVID ROMPRE
ZAMA HIGH SCHOOL

ACTIVITY: **BLACK BOX "MATERIALS IDENTIFICATION"**

PURPOSE: In materials identification the student will

1. Make multisensory observations of black boxes.
2. Communicate ideas through discussion.
3. Develop a hypothesis based on previous knowledge.

OVERVIEW: In black boxes "materials identification" students work in groups of two to identify the contents of sealed black film containers. Students are asked to list their observations and to conclude what each box contains.

This activity was done with an eighth grade class of twenty students. A total of ten film containers were constructed using a variety of materials Each box was painted with an identification number at the top. Students were given three to five minutes to make and record their observations before switching boxes with another group. Eventually each student examined all ten containers. Since members of each group did not always agree or have the same observations, each student was asked to record their own observations. In addition, each student was asked to write down what they thought was in each of the containers. Students were given the option to draw a picture of the contents of each container.

I concluded the activity by asking students what they thought was in each of the containers and why. This allowed for some lively discussion and comparison of observations. Although students expected confirmation from the teacher as to the accuracy of their guesses, no absolute confirmation was given.

MATERIALS for black box materials identification.

10 empty film containers

1 role of black electrical tape

1 white paint pen

suggested content items for film containers:

marbles

ball bearings of various sizes

aluminum cubes

steel cubes

wood cubes

metal washers of various sizes

coins

paper clips

wood or metal screws

metal nuts

wooden dowel pieces

plastic buttons

BB's

*cotton balls (optional)

*a magnet to be supplied to students only if they request one for identification purposes.

GETTING READY

1. The actual exploration portion of this activity will require a full 45-50 minute period. Having students record their observations will make it easier to resume discussion the following day.

2. **Preparing the containers:** Once the necessary materials are located the actual preparation of the film containers is a relatively simple matter. There are a variety of options as far as materials or combinations of materials are concerned. I listed cotton balls as optional in the materials section in case you wish to them as a "dampening" material in one or more containers. Be sure the tops of containers are secured with electrical tape to prevent the curious from sneaking a peak.

3. Allow ample time for discussion and answer comparison at the end of the activity.

4. Don't forget to make a list for yourself as you fill the containers with various objects.

MILK CARTON MADNESS

BY

LELAND WALBRUNCH
EDGREN HIGH SCHOOL

MILK CARTON MADNESS (Black Box)

ACTIVITY #1

STRAND

Scientific Reasoning

SCIENCE CONCEPTS

Thinking Process
Controlled Equipment
Variable

SCIENCE THINKING PROCESS

Categorizing
Observing
Comparing
Organizing
Relating

PURPOSE

In "Milk Carton Madness" the students will:

Investigate an unknown using various senses

Gain experience with variables

Conduct a controlled experiment

Gather and organize data in order to draw conclusions

Learn concepts that will contribute to understanding of the following themes

THEMES

Pattern
Structure
Change
System

OVERVIEW

Science is a body of information including all the hypotheses and experiments that tell us about our environment. All people involved in scientific work use similar methods of gaining information. One important scientific skill is the ability to obtain data from the environment.

Observations must be based on what actually happens or what we perceive happens in the environment. Equally important is the ability to organize this data into a form from which valid conclusions can be drawn.

Science is not just a collection of facts for students to memorize. Rather it is a process of applying their observations and intuitions to situations and problems formulating hypotheses and drawing conclusions. "Milk Carton Madness" invokes the thinking processes.

What are the thinking processes. The most basic process is observing.

Through observation - seeing, hearing, touching, smelling and tasting - the student begins to gather information regarding size, shape, texture, or quality of an object or event.

The following statements may begin to assist students to focus their observation.

"What does the object sound like?"

"What shape is the object or container?"

"What characteristics can you observe?"

Students can then begin to organize the information acquired through their observations. This process of organizing information encompasses ordering, organizing and comparing. When ordering information events are placed in a sequence that tells a logical story. By looking at similarities and differences, objects, or ideas can be compared.

Next students will become involved in the process of inferring. Inferences are logical conclusions based on observations and are made after careful evaluation of all the available facts or data. Inferences are a means to explain or interpret observations. Have students focus on the process of inferring by asking the following questions:

"What can you infer from the data gathered during this experiment?"

"Discuss within your team the data that supports your predictions."

This leads to the communication part of science. Once information is gathered it is necessary to organize the observations or inferences. This information may be presented in tables, charts, models and diagrams which make it easier to consider the facts. The following questions may assist students in this process:

"Compare what is happening inside each of the milk cartons."

"Diagram and share your inferences about the inside of the milk carton."

"Contrast the milk cartons."

Another process that is important is "relating" cause and effect. This process focuses on how events or objects interact with one another. It also involves examining dependencies and relationships between objects and events.

Use the following questions to invoke this thought process.

"Is there a relationship between where they were found and the difference in the container?" "Why or why not?"

For each group of four students

4 milk cartons labeled: *

A (Found in garbage can within cafeteria
B (Found on sidewalk outside of cafeteria)
C (Left on table in cafeteria)
D (Found on floor of cafeteria

* Please note the variable of where carton was found is added because of a lunch time cleanliness problem that we have experienced at Edgren High School. I found it was a great way to discuss the problem and variables at the same time.

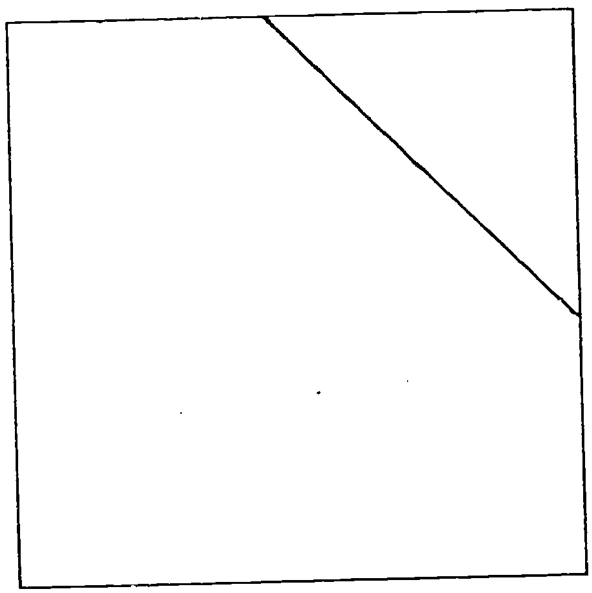
GETTING READY

1. Schedule the activity. This activity will take one 50 minute session to complete. Additional time might be necessary if students are expected to report their findings and conclusion to the total class.

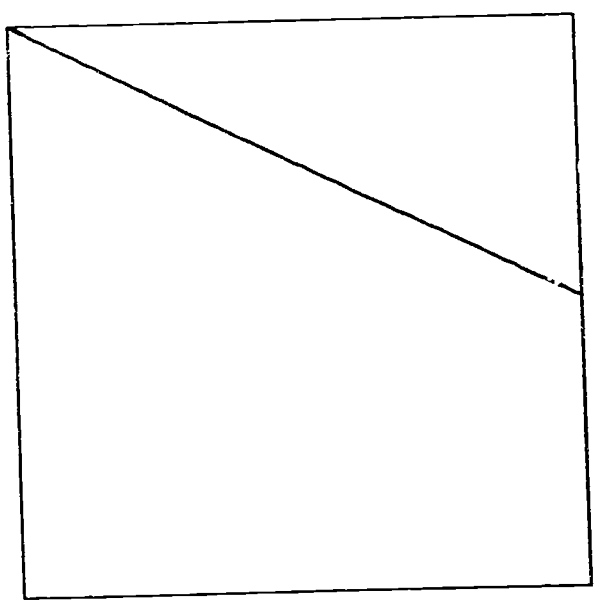
2. Construct "Milk Carton Madness" containers

Use milk carton parts to make the divisions in each container

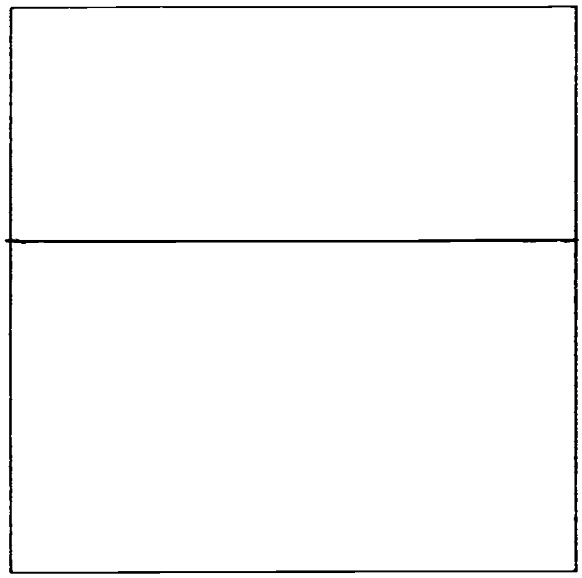
A. Top view of carton, a barrier is glued (use hot glue for best results) Place a glass/steel marble in the largest area of the carton.



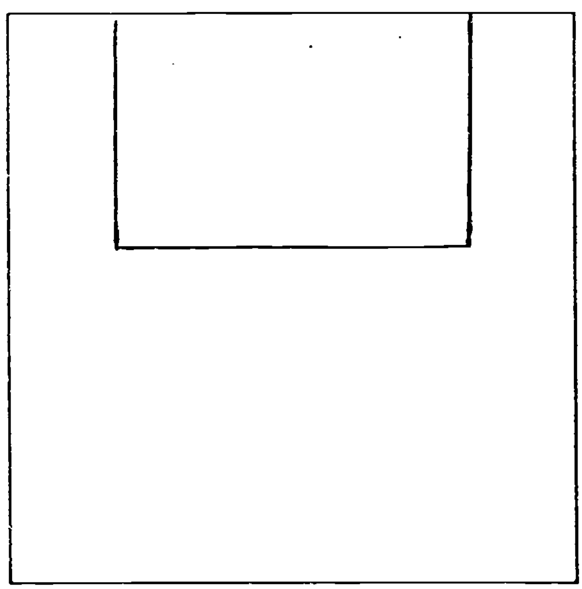
B. Top view of carton



C. Top view of carton



D. Top view of carton



OBSERVATION SHEET

Name_______________________________________ Date:____________________

MILK CARTON MADNESS

Write a complete description of the contents and a diagram based on your inferences. (DO NOT OPEN THE CARTON)

CARTON A:(Found in the garbage can within the cafeteria)

CARTON B: (Found on sidewalk outside of cafeteria)

CARTON C: (Left on a table in cafeteria)

CARTON D: (Found on floor of cafeteria)

DOING THE ACTIVITY

Part 1: Form Work Teams

Organize your class into work teams. Random selection by draw of playing cards might be desirable.

Part 2: Introduce the Activity

Explain to the students the problem of finding milk cartons at various places near the cafeteria. Discuss that each milk carton appears to be different. Their task is to find out how they are different from each other.

Part 3: Distribute the Student Data Observation Sheet "Milk Carton Madness:

Part 4: Explain to the students that answering specific questions for each of the cartons might be an excellent method to begin with.

Examples include:

"What does the object sound like?"
"What shape is the object or containers"
"What characteristics can you observe?"
Compare what happens in each of the milk cartons.
Contrast what happens inside each of the milk cartons.
"Is there a relationship between where they were found and the differences in the containers? Why or Why Not?"

Part 5: Report each groups observations to the class

REFLECTING ON THE ACTIVITY

To begin have students individually complete the "Milk Carton Madness Performance Checklist". This will allow students to reflect on their personal involvement on the team and may be used as an assessment tool.

Self-management
Problem Solving
Leadership

NAME: ______ CLASS: ______ DATE: ______

"MILK CARTON MADNESS" PERFORMANCE CHECKLIST

Poor 1
Average 2
Above Average 3
Excellent 4

Student Self-check		Teacher
	Self Management	
1 2 3 4	Exhibits Self Control	1 2 3 4
1 2 3 4	Organizes Tasks, resources and self	1 2 3 4
1 2 3 4	Perseveres in completing the task	1 2 3 4
	Problem Solving	
1 2 3 4	Defines the problem	1 2 3 4
1 2 3 4	Develops background information on the problem	1 2 3 4
1 2 3 4	Evaluates the alternative solutions	1 2 3 4
	Leadership	
1 2 3 4	Organizes group	1 2 3 4
1 2 3 4	Involves all group members	1 2 3 4
1 2 3 4	Contributes to completing task within scheduled time	1 2 3 4