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ABSTRACT

This teacher's guide offers classroom techniques for teaching science to bilingual elementary students. Recommendations are made for improving teaching by: lowering students' affective filters; providing comprehensible input; providing for language output; creating a supportive environment; adjusting classroom teaching style; teaching heterogeneous groups; motivating participation; using students' background knowledge; and providing concrete support for student efforts. A sample unit entitled "What Is Science?" is outlined in seven detailed and varied classroom activities. (MSE)

Que es la Ciencia? What is Science? A question for all students.

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SCIENCE FOR THE BILINGUAL CLASSROOM

Teacher's Guide

INTRODUCTION

Welcome to Unit 1 of *SCIENCE FOR THE BILINGUAL CLASSROOM,* a series of science units created to give you experiences using content based ESL instruction. This teacher's guide is designed to assist you in both the theoretical and practical aspects of using the units.

Overview

Your involvement with this unit will be on two levels: as a teacher, teaching science lessons to elementary students as well as teaching English through science content and as a reflective teacher thinking about what you teach and how you teach it.

As a teacher, you can conduct the science lessons and activities in the native tongue of your students or using English in an ESL setting. Through practice, you will build your academic vocabulary and communication skills as well as your confidence in teaching science. As a reflective teacher, you can address the questions that occur (in boxes) throughout the lesson.

BACKGROUND

Improving your science vocabulary in Spanish or the native tongue of your students

Jim Cummins proposes that there are two aspects of linguistic ability.

BICS: basic interpersonal communicative skills

- is social language
- used for everyday things - concrete, contextual clues
- help interpret meaning
- takes 2-3 years to reach level of native speakers

CALP: cognitive / academic language proficiency

- largely determines success or failure in school
- is the language of texts and testing
- is context-reduced language
- takes 5 - 7 years to reach level of native speakers

Most bilingual teachers and prospective bilingual teachers educated in the United States, through no fault of their own, do not know science terms, for example, in Spanish. This is understandable because you probably received science instruction in English; you were never taught science terms in Spanish. You must therefore consciously develop your cognitive academic proficiency in science so that you can teach your students this academic vocabulary.

The science terms and concepts which you know in English will help because of the CUP, the cognitive underlying proficiency. What you know in one language is readily transferred to the language you are learning. This CUP will also work with your students; the science vocabulary and concepts which they know in Spanish will be readily transferred to English.

Using science to teach English to second language learners

Many of you will be assigned to teach ESL; you may choose to integrate your curriculum, using science lessons to teach English. Teaching English through engaging and interesting content makes sense given the findings of the language acquisition literature. From the literature, we know to:

LOWER STUDENTS' AFFECTIVE FILTERS

- reduce their levels of anxiety
- make the child feel welcome and a part of your class
- focus on the meaning of the child's language, not the correctness of grammar
- accept a student's silent period
- be fair
- acknowledge the child's contributions to the class
- provide for readily available help
- provide for meaningful, contextualized language use
- focus on engaging activities and relevant content

PROVIDE COMPREHENSIBLE INPUT

- teach content in English using strategies and techniques to make content comprehensible
- integrate language and content
- incorporate content into language classes
- modify language and materials for content classes

PROVIDE FOR LANGUAGE OUTPUT

- science lessons need to include time for discussion and sharing of stories or the findings from their activities
- have students act on what they are learning through language, written or oral.

Students are generally interested in the world around them and are enthusiastic about hands-on projects and activities. Science lessons that employ concrete activities can provide conditions which lower students' affective filters and provide support for comprehensible input. Science lessons also stimulate language production; students are eager to talk or write about what they know and what they have learned in science. Specific suggestions for teaching science in English to second language learners are offered below.

SUPPORTIVE ENVIRONMENT

- write objectives/activities on board and review before the lesson
- print/write legibly
- list and review instructions step-by-step
- summarize frequently
- conduct visual reviews with lists and charts
- get students to summarize orally

TEACHING STYLE

- use a student-centered learning approach
- reduce teacher-talk; let students talk
- adjust language input, but not to the point of being unnatural
- slow speech rate; longer pauses between phrases and enunciate clearly

- control your vocabulary
  - avoid idioms
  - be aware of words with multiple meanings
  - use simple verb tenses
- control sentence length; don't put too many new topics in one sentence
- focus on meaning of students' responses vs. grammatical correctness; model correct grammar
- repeat, restate, expand, give examples
- use choral responses

STRATEGIES FOR HETEROGENEOUS CLASSROOMS

- cooperative learning
- peer tutoring
- process writing
- hands-on, concrete activities

MOTIVATION

- use language and events from students' worlds
- make learning fun

BACKGROUND KNOWLEDGE

- introduce new topics by having students share what they know/have experienced about the topic
- begin units with K - W - L technique
- use real, concrete items (e. g. maps, photos, objects) to introduce topics

CONCRETE SUPPORT

- act out meanings with gestures and facial expressions
- use lots of visuals and manipulatives, authentic materials, charts, graphs, displays, or props from the real world
- demonstrate/model
- use visual/audio input
- provide hands-on activities

- incorporate sustained silent reading time using content materials or science trade books

Just as there are relevant theoretical assumptions from the language acquisition literature which pertain to these units, there are also some generally accepted assumptions from the science education literature. There are presented below.

LEARNING SCIENCE

- Learning outcomes depend not only on the environment, but also on what the learner already knows, their prior knowledge. Students' experiences, ideas, and interpretations will influence the way they interact with the learning materials and concepts.
- Learning involves constructing meanings. Students construct meanings of what they hear or see by generating links between their existing knowledge and the new phenomenon
- Construction of knowledge is a continuous and active process; it takes time.
- Newly constructed meanings once constructed are evaluated; they can be accepted or rejected.
- Ultimately, students are responsible for their own learning; they have to direct their attention to the learning task, draw on their present knowledge to construct meaning, and evaluate that meaning.

Bringing the elements of language instruction together with elements of science instruction is not as problematic as it would seem; in fact, it makes sense. Both fields insist on considering the prior knowledge of learners, providing meaningful, relevant content instruction, and on using concrete experiences and support. Science and language both are concerned with "meaning making". And finally, our bilingual students need strong backgrounds in both areas to be able to participate fully in and to attain the benefits of society.

UNIT 1
What is Science ?

What We Think about Science	What's in the Bag?	It's Peanuts	Nuts and Graphs	Predicting
Oobleck: Lab	Oobleck: Convention	Oobleck: Design Lab	I'm a Scientist	I'm a Scientist

The activities in this unit are:

What We Think about Science: You explore your personal notions of what science is and what your students think about science and scientists.

What's in the Bag?: Students use their senses to collect data and create a scientific model. Students explore "what scientists do".

It's Peanuts: Students experience the importance of making and recording detailed observations.

Nuts and Graphs: Students practice classification and graphing skills.

Predicting: Students make predictions based on previous experiences and distinguish predicting from guessing..

Oobleck: Lab, Convention, and Design Lab: Students experience the work of scientists beginning with discovery and ending with applying their new knowledge to a design project.

I'm a Scientist: Students view themselves as scientists based on what they have learned in this unit.

In this unit, the lessons follow the **5-E Instructional Model.** Use it as an important alternative to the Madeline Hunter model; it promotes student-centered activity and communication.

The 5-E Instructional Model

ENGAGEMENT:
Teachers raise questions, present stimulating events, make connections between past and present experiences, or in any interesting, motivating or meaningful way to draw students' attention to the instructional task at hand.

EXPLORATION:
Teachers provide students with a common base of experience through hands-on/minds-on activities. As students explore, the teacher facilitates and monitors interactions.

EXPLANATION:
Students communicate their understandings, findings, use of skills, and express their attitudes and opinions to peers and teacher.
Teachers listen carefully, accepting student responses. Teachers direct student learning by clarifying the concepts and providing vocabulary for concepts learned during the activities. Direct teaching occurs during this part of the lesson.

ELABORATION:
In order to broaden understanding, teachers provide experiences for the students to apply their new knowledge and skills.

EVALUATION:
Formally and informally, teachers assess student understanding and progress. Students also evaluate their own understanding and progress.

What is Science?

WHAT WE THINK ABOUT SCIENCE

CONCEPTS

Students bring their conceptions about of what science is and what scientists do to the classroom. This prior knowledge is important because it impacts what students learn or how they continue to construct their knowledge of what science is.

VOCABULARY

science, scientists

SCIENTIFIC PROCESS SKILL

communicating

TIME

30 minutes

MATERIALS

paper, pencils

TEACHER PREPARATION

Find three pictures of people engaged in "doing science". National Geographic often has non-stereotypic photographs of a variety of people "doing science".

Prepare and post word cards: science, scientist.

Write your definition (not one from the dictionary) of what science is and a short description of what scientists do. What kinds of people become scientists?

ACTIVITY

Sit with students at a table; you need paper and pencil. Begin by telling them that you will be doing a science unit for the next two weeks.

Conduct a three-part discussion. Take notes of students' responses; you will need them for an assignment.

1. Ask students, showing the word card, What is science? Have each student write a short definition. Make sure each student contributes. Have a student summarize.
2. Ask, What do scientists do? Do what you did on the first question. Allow students to tell stories because that is often how they express their knowledge.
3. Show the students the three pictures of the scientists and ask them to describe what the scientists are doing. Have them write several sentences describing what one of the scientists is doing. Collect their responses, and read several to the group. [Do they use any words that we normally associate with science (e.g. experimenting?] It would be interesting to ask students what kinds of people become scientists or if they would like to become scientists.]

Close the lesson by reviewing the words science and scientist and tell students that tomorrow they will do an activity to learn more about what scientists do.

Using your notes from the discussions with your students and their sentences about the scientists, answer these questions: What do students think science is? What do they think scientists do? Where do you think students have gotten these notions?

What is Science?
WHAT'S IN THE BAG ?

CONCEPTS

Science is one of the ways humans use to make sense out of the world. Therefore, everyone at one time or the other is "doing science".

Some people learn best from doing and discussing their discoveries. Many scientists work in this way, but it is not the only way to think and acquire knowledge. Thomas Edison tinkered around with objects to make his great discoveries while Einstein worked mainly in his head. Students in this activity and others to come will participate in the activities of scientists.

Scientists investigate universal phenomenon in the field and in the lab. They observe by using all of their senses which are often extended through the use of instruments. Einstein made up this activity to show students that they cannot always look inside what they are studying, like atoms or cells, and will sometimes have to use extensions of their senses to investigate. Even then, the knowledge obtained is only a model of reality, not a hard fact.

Scientists record data from their observations which they quantify by turning it into verifiable numbers. They interpret this data by thinking and discussing with others and by making hypotheses. Often scientists create conceptual models, as drawings, three dimensional constructions, or mathematical formulas. They use these models to make predictions, interpret new data, and draw conclusions. In this process, scientists often make mistakes and have to try again. They often disagree. They often attempt to resolve their disagreements by further investigation/ observation and discussion/debate - a process that never stops. Enjoy this with your students!

VOCABULARY

observe, five senses, data, interpret, model, hypothesis, conclusions

SCIENTIFIC PROCESS SKILLS

observing, communicating, inferring, hypothesizing

TIME

30 - 45 min.

MATERIALS

(for 30 students - 6 groups of 5)

6 medium brown paper bags (lunch bags are too thin)

6 plastic fruit/ veg. bags or quart size baggies

6 small apples - the cheap ones

6 small potatoes - any recognizable, firm vegtables will do

12 unshelled peanuts or any item that might go unnoticed

a lemon

(for one group of 4-5 students, prepare 2 bags)

TEACHER PREPARATION

(Prepare one bag for each group) Put an apple, a potato, and two peanuts in a plastic bag (grocery store produce bags work well). Fill the bag half full of air and tie tightly. Put the plastic bag inside the paper bag and twist shut tightly; make sure they are not leaking. Do not let students see this! Just before the lesson and out of sight of the children, squeeze a lemon peel so that it squirts oil on the bag; then rub the bag with it. Don't use lemon juice or oil - it ruins the bag.

Draw this grid on the chalkboard.

smelling	hearing
touching	seeing

Prepare and post vocabulary word cards.

ACTIVITY

ENGAGEMENT

Keep all bags but one out of sight. Begin the lesson by asking students a series of questions like these:

What's this? What's in the bag? What do the rest of you think? How do you know? What hypotheses do the rest of you have?

Don't take too long with this first part; students will lose interest.

SCENARIO: "We are scientist trying to determine what is inside of this bag, but **WE CANNOT OPEN THE BAG**". Ask them what you can do to find out. They may say - drop it , shake it, etc. Do a few of these. Ask them, "What is your mental picture of what's in the bag?" and let them respond.

EXPLORATION

Then tell them that your lab is turning the objects over to teams of scientists. Give each group a bag and tell them that they will determine the contents of the bag together. **THEY CANNOT OPEN THE BAG.**

Have students draw a grid on their paper like the one you drew on the board. Tell them that they will be using their sense to make a model of what's in the bag. Good questions to use throughout this activity in response to student observations are, "What makes you think that?" "How do you know?", or "Why do you say that?".

Show and post the word cards when you use the words in your instruction.

1. Set the bags on the table and tell them that they cannot touch it yet. Tell them that they can only smell it. Ask for volunteers to **hypothesize** about the contents of the bag. In the upper left part of the paper, have them draw their **model** based on **data** gathered by smelling.
2. After students have drawn their first model, tell them they will collect more data by using their sense of hearing. They cannot touch the bag yet. Pick up a bag and shake it for each group (or student). Tell them to listen

carefully. You might ask them, "How many things? Are they round? Large? Small?". Again, ask for an **hypothesis** about the contents of the bag. Tell them to draw their new model based on the additional data from their sense of hearing in the upper right hand box.

3. Now tell them to use their sense of touch to expand their model. Remind them that they cannot open the bag and that all students need the opportunity to collect data. Give them some time at this point; they will need it. When they have had some time, tell them to draw their third model based on the new data in the lower left part of their box.

At this point in the lesson, have several students share with the group what their third model is. Allow for classroom discussions and disagreements.

4. Student enthusiasm will be high at this point. Have them wait and open the bags together. Tell them they will collect their last data using their sense of sight. Make sure they draw their fourth and final model.

EXPLANATION

When the students have completed their observations, discuss with them what they have discovered, what their final models look like. Ask them what they now think scientists do, and what **conclusions** they can make about scientists. Encouraging them to use the vocabulary words that you have been using.

Ask them about how they **interpreted** the smell of lemon. Tell them that you used the lemon to show them how they could ignore/or not even use senses if they thought that they already knew something. If you walked into a room and smelled lemons would you know there was lemonade? Could it be Lemon Pledge?

Explain to them that scientists answer questions by making observations. [As you use the vocabulary words, show them the word cards once again or write the terms on the board.] Scientists record (write down) what they observe so they won't forget later and so they can make hypotheses. Tell them Albert Einstein did this activity with college students so that they

could learn about the work of scientists. Ask them why he did this? Let them respond. Explain that scientists often cannot look inside what they are studying - they can only make hypotheses, do experiments, interpret data, and make models. But they have to change the model when they get new data. For example, at one time, people thought that the earth was the center of the universe and that the sun went around it. But as scientists gathered more data, it became clear that the earth and the other planets actually go around the sun.

Review the vocabulary and close by asking them what they have learned. Tell them that tomorrow they will sharpen their observation skills.

ELABORATION:

Have students find out about famous Spanish, Mexican, or Mexican American scientists. Do other activities using the senses.

EVALUATION

Evaluate students informally on their participation and cooperation or have each student write a paragraph describing what they learned about "doing science".

Contrast this way of teaching students about how to do science and the standard textbook presentation of "The Scientific Method".

What are the advantages of teaching students about science through simulations of scientific activity?

How is language ability developed through this type of activity?

What is Science?
IT'S PEANUTS

CONCEPTS

Often we look at everyday objects without noticing anything about them. Learning to make careful and detailed observations is one of the most important things we can get from our studies of science. Becoming a good observer takes time and practice; one way to begin is to observe an object carefully in order to draw it. A famous paleobotanist, Ted Delavorius, says that you don't really see something until you look at it in order to draw it. When we begin to look at details, objects begin to appear differently to us; similarities and differences surface that we never observed before.

VOCABULARY

observation, similarities, differences, measure, characteristic, identify

SCIENTIFIC PROCESS SKILLS

observing, describing, measuring

TIME

20-30 minutes

MATERIALS

3X5 notecards, unshelled peanuts (about 5–6 peanuts/one student), rulers, a field guide with drawings of plants, animals, insects, shells (The Golden Guides or the Peterson Field Guides are readily available in libraries)

TEACHER PREPARATION

Prepare and post word cards: observe, measure, similar, different, characteristics, identify (Characteristic is a hard word for elementary students to grasp, but is one that occurs frequently in science readings.)

ACTIVITY

Review the vocabulary words from yesterday. Explain to students that you will continue learning about science and scientists.

ENGAGEMENT

Invite several students to come to the chalkboard and draw pictures of unshelled peanuts. Point out the details in each drawing and ask the class

"If you saw this drawing on a bathroom wall, how would you know that it was a peanut?".
Explain to students that you will be making detailed observations of unshelled peanuts.

EXPLORATION

Place one pile of unshelled peanuts on each group's table (6 peanuts/student); give each student a notecard and a ruler. Tell each student to pick one peanut that they want to get to know through detailed observation. Tell them to pay close attention to the unique characteristics of their peanut. Instruct them to make a detailed drawing of their peanut; tell them that if they wish, they can use a ruler to take measurements of their peanut.

When all students have completed their drawings, collect all the peanuts and mix them in with the original pile. Have students **identify** their peanut (most will be able to). Tell students to return the peanuts to the pile and mix them up again.

Next have students exchange drawings so that they have to use another's drawing to **identify** that particular peanut. Tell them to be ready to explain how their friend's peanut was **similar** to or **different** from their own peanut.

EXPLANATION

Ask students if it was easy or hard to find their own peanut. Ask what it was like to use someone else's drawing to identify a peanut. Discuss with them how they could have made better, more detailed drawings of their peanut.

Explain to students that scientists make drawings and photographs of organisms and objects in order to study them and also to help others identify the particular organisms or objects. Show them field guides used to identify organisms; ask them if they think they could use a field guide to identify organisms. [It might be interesting to bring in the recent

photographs of the distant planets in the solar system to show them how, with the pictures, it is easy to identify Saturn or Jupiter.]

Review the vocabulary and explain to the students that tomorrow they will use the peanuts to do another activity.

ELABORATION

Use field guides to identify trees in the schoolyard. Have students make observations of the moon over a two week period [The moon is often only visible during the day]. Allow students to select a natural object or an animal that they want to observe over a period of time. (Baby brothers make interesting animals to observe.)

Discuss what instruments scientists use in collecting their data such as telescopes, microscopes, stethoscopes, X-ray machines, etc.

EVALUATION

Ask students the importance of making careful and detailed observations. Give each student a miniature Hershey's candy bar and have them use all their senses (and a ruler) to make detailed observations of it.

How could you tie this lesson in with a language arts activity?

What is Science?

NUTS AND GRAPHS

CONCEPTS

In trying to make sense out of the world and to give it order, scientists classify objects and events. For example, scientists classify different types of animals based on their similarities and their differences. For example, there are fishes, amphibians, reptiles, and mammals. Mammals can be further classified as marsupials, rodents, bats, whales, primates, etc. Students need to practice classifying objects.

Often, scientists use graphs to communicate information about classes of objects. Presenting information graphically is part of the cognitive academic language of science necessary for students' success in schools.

VOCABULARY

classify, similarities, differences, X-axis (abscissa), y-axis (ordinate), graph

SCIENTIFIC PROCESS SKILLS

observing, classifying, measuring, communicating

TIME

30 minutes

MATERIALS

unshelled peanuts, rulers, overhead transparency, paper

TEACHER PREPARATION

Prepare and post word cards. Also, prepare a visual for the graphing portion of the lesson; you can draw an x- and y-axis on a poster board (label them). If you laminate it, you can use vis-a-vis pens and use it for many lessons. If you do this, be sure to leave plenty of room at the bottom under the x-axis and to the left of the y-axis so that you can label it.

From your picture file (Start one if you have not; remember the importance of concrete examples!), gather pictures of different types of animals, so that you can demonstrate classification. [National Geographic

is an excellent source of animal pictures; you can buy old issues at Half Price Books for 25 cents each.]

ACTIVITY

ENGAGEMENT

Display the animal pictures. With your students, show them how you can classify the group of animals. Ask students if they can think of another way to classify the same group of animals and go through it with them. [You could classify them according to kind of animal (fish, amphibian/reptile/mammal, big/little, pets/wild, from Texas/not from Texas etc.].

EXPLORATION

Give each group a pile of unshelled peanuts. Write these instructions on the board and review them with the students:

1. Look at your peanuts. Separate the peanuts into two classes based on similarities and differences. What characteristics did you use?
2. Put all the peanuts back in the pile. Using different characteristics, separate the peanuts into three piles. What characteristics did you use?

EXPLANATION

When students are finished, discuss with them the different ways of classifying the peanuts. Have each group share with the class the characteristics they used to classify their peanuts.

Next, review the parts of a graph, point out the x- and the y-axis. Remind them that each axis is always labelled so that others can read and understand what they are trying to communicate. Show them a graph of peanuts classified according to broken/unbroken shells. Label the horizontal axis, the x-axis, as classes of peanuts and label the y-axis, number. Present your findings to them. See example below.

Have student draw and label a graph of one of their classifications of the peanuts. Let each group share their results with the class. [If you allow them to do this on transparencies and use the overhead to present their results, you will get high involvement and ownership in the lesson.]

Close by asking students what they have learned. Then explain them that biologists use number of legs as one of the ways to distinguish insects, which have 6 legs, from spiders, which have 8 legs. Then review the vocabulary words.

ELABORATION

Describe an activity that you could use with students to elaborate on the concept of classification.

EVALUATION

Have students classify the objects in the classroom which have legs (people/objects, two legs/four legs, etc.). Provide them with a skeleton of a graph and have them graph their results.

Teachers must have high expectations of bilingual students. How can you have high expectations during this kind of lesson? (Think accountability!) What specific expectations during this lessons will help students master the cognitive academic language of science?

What is Science?
PREDICTING

CONCEPTS

Scientists make predictions based on past observations, experiences, or reasoning. Students can learn to predict; you can teach them to consider what they have seen or experienced to make predictions. Students also can be taught the difference between guessing and predicting. Predictions are based on previous information or patterns in events whereas guessing is not.

Meteorologists predict the daily weather based on weather patterns that have occurred in the past. Geologists predict earthquakes based also on the events that have led up to previous earthquakes.

VOCABULARY

predict

SCIENTIFIC PROCESS SKILLS

classifying, predicting, communicating

TIME

30-45 minutes

MATERIALS

one box of animal crackers/group OR one mini-bag (trick-or-treat size) of M&M's/student, paper

TEACHER PREPARATION

Purchase cookies or candy. Prepare and post word cards. Read about predicting the weather or earthquakes.

ACTIVITY

ENGAGEMENT

Hold up your purse (male teachers - Borrow one if you don't have your own!). Ask students to predict what you might have in your purse. Write their answers on the board. Show them the items that they have predicted correctly and ask them what made them make those predictions. Tell

them that they were able to predict some of the contents of the purse based on experiences with purses from watching their moms or sisters. Tell them that predicting is different from guessing and explain how.

EXPLORATION

Give each group a closed box of animal crackers (McDonalds may donate them to you; ask the manager.) OR each student a small package of M&Ms. The important thing here is that the students have had previous experience with either animal crackers or M&Ms.

Have them predict the kinds of animals that will be in their box. When they have made their list of animals (see student worksheet), have them predict the numbers of each animal that they think they will find.

Next, have students open their boxes and classify their animals according to kind of animal. Have them add to their list or delete animals from it. Also have them record the number of each type.

EXPLANATION

Have each group prepare a graph of the contents of their box to share with the class. Use either transparencies or have them draw their graphs on the board. Get students to compare the contents of the different boxes. Ask them what was the basis of their predictions? Were their predictions right or wrong?

Tell students that next week, you will continue to learn about the activities of scientists. An interesting homework assignment would be to have students interview an adult and ask, "What do scientists do?. Have them record the answer and bring it to share with the class.

ELABORATION

Explain to students how scientists predict the weather or earthquakes.

EVALUATION

Ask students the difference between guessing and predicting.

These lessons present students with experiences that not only help them construct more accurate pictures of what scientists do but also that help them develop their thinking skills.

What is the importance of teaching bilingual students about science and developing their higher level thinking skills?

What is Science?
OOBLECK

CONCEPTS

Scientists use their senses to gather data. Scientists often work in teams to make new discoveries and sometimes scientists disagree about their findings. Information from scientific labs is used by engineers to create and design technology.

VOCABULARY

sample, properties, investigate, describe, liquid, solid, space probe

SCIENTIFIC PROCESS SKILLS

observing, describing, communicating, drawing conclusions

TIME

This activity will take three days; about 30-45 minutes each day.

MATERIALS

FOR THE CLASS: lots of newspaper, masking tape, bottle of green food coloring, 1 extra 16oz box of cornstarch, large bowl or bucket, water, paper towels, (optional) selection of wooden, plastic objects "tools", hot plate and saucepan. FOR EACH TEAM: one, 8" aluminium pie pan or deep plastic bowl, 1 16oz box of cornstarch, markers, 2 large sheets of paper.

TEACHER PREPARATION: Allow about 1 hour to prepare. Cover the tables or work areas with newspaper.

Prepare the Oobleck - (enough for 6 teams to have 1.5 cups each) 4 boxes of cornstarch to 1600ml (6 &3/4 cups) of water, 16 drops of food coloring. Add the coloring to about 2/3rds of the water. Put this in a mixing bowl and then add the 4 boxes of starch and the rest of the water. Swirl and tip the bowl to level the contents. Let it sit. About 15 minutes before beginning, mix Oobleck by hand; "lift" it from the bottom until an even consistency is reached. **Oobleck should flow when you tip the bowl, but feel like a solid when you tap it. Adjust by adding water or cornstarch. Pour 1 1/2 cups in each team's bowl before you begin.

If making Oobleck for one group, use 1 box of cornstarch, 400ml of water (a little over 1 1/2 cups), and 4 drops of green cake coloring.

Cover the Oobleck with plastic after each class. Also, you may have to add a little bit of water if it has dried out.

Prepare and post word cards.

TROUBLESHOOTING

Students get very excited during this activity. Make sure the work area is completely covered with paper. Set up and review rules of investigation. Suggestions are:

- Use a 12 inch voice: a voice that can only be heard 12 inches away (This will keep the noise down. Demonstrate a 4 foot voice vs. a 12 inch voice.).
- Only one scientist's hands in the bowl at a time.
- Keep all Oobleck and your hands over the table.
- No one washes their hands until we are through.

ACTIVITY

DAY 1: ENGAGEMENT

SCENARIO: Tell students that a space probe has just returned from a planet in another star system. The planet was covered with large, green oceans and samples were brought back. Tell them that they are a group of scientists gathered to determine the **properties** of the ocean **sample** from outer space. Explain that the material has been named Oobleck because it looks like the green rain in Dr. Seuss' Bartholomew and the Oobleck. Inform them that scientists have determined that Oobleck is safe to handle and that scientists are working on finding out what it is made of.

Explain to them that their job is to **investigate** and **describe** the **properties** of Oobleck. Use an example to explain what is meant by "**property**" of a substance. For example, hold up a piece of chalk and ask students to describe it. Write their answers on the board- possible student responses are: it's white, it's powdery, it's hard etc. Drop it and ask what that tells

them about the chalk. A property of a substance is something that can be seen, heard, smelled, felt, by the senses, or detected by instruments. For example, color, size, shape, hardness, odor, sound are examples of properties.

EXPLORATION

Have students investigate Oobleck in their groups. (Take the bowls to them). After they have been investigating for about 5 minutes take each group a large sheet of paper and tell the that they are to make a list of properties of Oobleck. Have them number the list. As they do this, circulate, asking questions and checking for understanding. Questions might include: "When does Oobleck behave like a liquid? a solid? For example, students sometimes think that it is the heat from their hands that makes it behave like a liquid. Get them to test this idea.

*Remind students that everyone on the team must agree on the property before it goes on the list.

Have each team put a star next to the property that they think is the most important.

Take up the bowls of Oobleck and dial 911 for cleanup assistance. Allow for plenty of time for cleanup.

DAY 2: EXPLANATION

[Tape the lists of properties on the board and have all students gather around so that they can see the board and see each other. Have one bowl of Oobleck on hand in case it is needed.]

Explain to your students that they are now in a SCIENTIFIC CONVENTION and the goals are not to prove each other wrong, but to find the truth and to state it as clearly and completely as possible.

Give them these rules of the convention:

- Only one property can be discussed at a time.
- Each team will demonstrate and explain the property they have starred.

- Students can agree or disagree but they must explain why.
- The wording of a property may be changed to make it more clear.
- When a property has been discussed, it will be voted on by the entire convention to determine if it is really a property of Oobleck. If 3/4 of the class votes "yes" on a property, it will be called a LAW OF OOBLECK.

You may want to let the teams each test each property under consideration. Do what works best for you.

Disagreements are starting points for important discussion. If no one disagrees with a property, you might ask "Can you think of a case where this property would NOT be true?" and see what happens.

**Very important for the students: Changing the wording of a potential law - adding phrases or defining terms (sticky=your finger gets stuck if pulled out fast) may help to make laws more acceptable to the convention. When the Laws are determined, wrap up this segment of the activity.

DAY 3: ELABORATION

[Write the LAWS OF OOBLECK on the board]. If you are starting after a break, or the next day go over them with the class. Tell the students that as a scientific team, their next assignment is to design a spacecraft that will be able to land on an ocean of Oobleck, explore the whole planet and take off again, with all passengers on board.

Tell the students that the planet is like earth except for being covered with Oobleck and having green skies. **Tell them that their designs MUST TAKE INTO ACCOUNT THE LAWS OF OOBLECK. Emphasize that the most important part of their design is how to design a craft to land safely and take off from the Oobleck.

Have students label those parts or features that allow the spacecraft to land and take off, without sinking or getting stuck in Oobleck.

Have them work alone or as a team.
As they work, circulate asking them how it will take off and how it will land. Remind them to label their drawings. DO NOT give specific design hints - you want to promote diversity and creativity.
When students are finished allow them to walk around the room and look at other designs.

When they are all seated, ask for volunteers to explain their drawings to the class. Have them go to the front and explain how it will land and take off. Give everyone who wants to participate a chance.

Ask students which will most likely survive the oceans of Oobleck.

Display students' designs.

EVALUATION

Wrap up the lesson by writing 3 columns on the board: LABORATORY, CONVENTION, SPACECRAFT DESIGN. Tell them they actually were acting like scientists do in this activity. With them, generate lists of behaviors they performed in each portion of the activity. Explain to them that they have used SCIENTIFIC METHODS in their work. (Remember: there is no such thing as the scientific method.)
[If you can get a picture of the Viking spacecraft that went to Mars, show it to them and tell them that scientists worked together like they did to design the craft.]

INTEGRATED ACTIVITIES:

Have students write stories about the kinds of creatures who live in the green Oobleck oceans. What do they look like, what do they eat, what do they think about Earthlings? etc. Read the Dr. Seuss book.

What have you learned about science and scientists from this activity?
What were the pro's and con's of using this type of noisy, messy activity with your students?

What is Science?

I'M A SCIENTIST

CONCEPTS

There are many different kinds of scientists. Some work mostly indoors in laboratories investigating the properties of things and some work outdoors also investigating things. Women as well as men are scientists; scientists work in every country around the world. Some of the different kinds of scientists are:

KIND OF SCIENTIST:	AREA OF STUDY:
biologist	living things
chemist	chemicals
physicist	energy and matter
botanist	plants
geologist	the earth
oceanographer	the ocean
astronomer	the stars and planets
paleontologist	dinosaurs/extinct organisms
[sometimes:]	
medical doctors	human health
veterinarians	animal health

VOCABULARY

as above

SCIENTIFIC PROCESS SKILL

communicating

TIME

2 class periods, 30-45 minutes each

MATERIALS

paper, colors

TEACHER PREPARATION

Prepare a chart of the different kinds of scientists; post it.

Collect pictures of different kinds of scientists.

ACTIVITY

DAY 1:

Review what you have learned about the activities of scientists. Write **WHAT SCIENTISTS DO** on the the board and list student responses under it.

Tell students about the different kinds of scientists; go over the list and have students repeat the words so that they can practice.

Ask them questions like: If you were a scientist, would you like to work inside or outside? What kinds of things would scientists do in their laboratories?

Pass out the paper and colors and instruct students to draw <u>themselves</u> as a scientist.

As they work, circulate around the class talking to students about their drawings. Ask questions like, "Tell me about your drawing." "What are you doing in this picture?"

When they are finished take up their drawings and tell them that tomorrow, they will write a story about themselves as a scientist. Review the kinds of scientists again.

DAY 2:

Return students' pictures. Instruct them to write a story about themselves as a scientist. Have them answer these questions in their story:

What kind of scientist are you?

What do you do?

Where do you work?

Choose a list of vocabulary words from the unit such as measure or predict that you wish for them to include in their stories.

Give students plenty of time to revise and finish their stories.
When they are finished, have them pair up with other students and read their stories to each other aloud.

If you choose the vocabulary carefully, you can use this activity to evaluate the entire unit.

What specific vocabulary words would you choose if you were using this final activity to evaluate students' learning throughout this unit? Give reasons for choosing each. Do you think this kind of evaluation (using a story about what scientist do) might be a better way to evaluate students' learning? Why or why not?

How could integrate the activities in this unit with math and social studies? Give specifics.

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