

***Cheap Thrills:  
Science Activities  
on a Shoestring***

**Seminars 3 and 4  
Teacher's Packet**

A KET professional development workshop for educators approved for Professional Development Training by the Kentucky Department of Education.

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# ***Cheap Thrills: Science Activities on a Shoestring***

## **Seminars 3 and 4: Inquiry Approaches to Learning Intermediate Science Content and Process**

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### **Overview of the Series and Seminars**

**Targeted Audience:** Elementary science teachers

All the supplies you will need for the activities presented in this four-part series may be found in your local grocery or hardware store. Ken Rosenbaum hosts the series, with two programs for primary teachers and two for intermediate teachers. The programs demonstrate how the activities—drawn from the areas of physical, life, and earth sciences—allow teachers to embed inquiry and scientific process skills in their instruction. All seminars include extensive classroom footage of students actually doing the suggested activities.

In the third and fourth seminars, targeted to intermediate teachers, Ken discusses how using authentic inquiry with students develops critical thinking skills and increases student learning and motivation. In a series of classroom demonstrations, Ken models ways to use inquiry to teach the scientific method and the science process skills to students in grades 4-5. Each demonstration includes an experiment using cheap and easy-to-find materials. Assisting Ken is Vera Prater, the science lab teacher at Fern Creek Elementary School in Jefferson County.

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#### **About This Teacher Packet**

This packet includes agendas for the two programs, a biography of the presenter, and specific materials related to seminar content. You'll find more details in the table of contents on page 3.

#### **Series Format**

These 90-minute programs were recorded in the KET distance learning studio. Any materials or information needed for participation in the seminar is provided in the videotapes and/or included in the teacher packet.

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## About the Seminar Presenter

Presenter **Ken Rosenbaum** is president of K R Consulting Inc. and executive secretary of the Kentucky Science Teachers Association. He also is a lecturer at the University of Louisville, Title II Coordinator for Jefferson County Schools, Region 3 PRISM Manager at U of L, and program designer for the Commonwealth Institute for Teachers at the Kentucky Department of Education. Before retiring from Jefferson County Schools in 1996, Ken spent nine years serving as K-12 science specialist and three years as K-8 science specialist. He also has 18 additional years' experience teaching science in Kentucky public schools.

Ken has been a frequent presenter at local, state, and national conferences and has participated in a number of special projects collaborating with community partners. Ken is a member of the NSTA Committee on Science Supervision and was 1995 Environmental Educator of the Year in the Jefferson County Conservation District. He can be reached by e-mail at <krosenbaum@aol.com>.

### **Professional Development Credit**

**Stage of Participant Development:** Practice/Application

**The Kentucky Department of Education has approved all KET Star Channels Seminars for professional development credit if schools or districts choose to include them in their professional development plans. Districts or schools may choose to include preparation and/or follow-up time as part of professional development. For example, if a teacher participates in one 90-minute program and spends an additional 30 minutes in related activities, he or she could be awarded a total of two hours professional development credit.**

**Individual teachers who wish to use these videotapes for professional development credit should check with their school professional development chair or with their district professional development coordinator.**

**Professional development can also be used to satisfy requirements for the fifth year program. Contact your local university or the Division of Teacher Education and Certification at 502-564-4606 for more information.**

# Seminar 3 Agenda

**Welcome and introduction**

Ken Rosenbaum, Presenter

**Teaching the scientific method the old way**

**Real science wondering: It's the question, not the answer**

**The components of inquiry lessons**

**The scientific method:  
Question-test-analyze-revise**

**Science process skills**

**Questioning skills: The Yes/No Game  
(What's in the Bag?)**

**Teaching and assessing process skills through inquiry**

- **The pulse glass: Classroom video**
- **Air pressure lab: Classroom video**
  - **Using question cubes**
  - **Analyzing the air pressure inquiry lesson**
  - **Extensions for air pressure lesson**

**Concluding remarks**

Ken Rosenbaum

# Seminar 4 Agenda

**Welcome and introduction**

Ken Rosenbaum, Presenter

**Review**

- **Components of inquiry lessons**
- **Scientific method**

**The components of inquiry lessons**

- **“What Is a Scientist?”**
- **“Growing a Plant”**

**“What Is a Scientist?” and “Growing a Plant”:** Classroom video

**Designing a science experiment**

**Balloon and polymers:** Classroom video

**Review of process skills for “Mers”**

**“Pretzel Phun”:** Classroom video  
(Using pretzels to teach classification)

**“George’s Potatoes”:** Classroom video

**Introducing the inquiry mystery box**

**The mystery box:** Classroom video

**Tips to remember**

**Concluding remarks**

Ken Rosenbaum

# Introduction

Science is wondering about the world around us and asking questions about it.

Inquiry starts with “I wonder” questions and proceeds when the learner designs tests (experiments) to answer these “I wonder” questions. The tests are revised many times and often proceed in unexpected directions. This is *real* science! “I wonder why the leaves turn color in the fall?” is a good science inquiry question. “How many angels can dance on the head of a pin?” is not. Good science inquiry questions can be tested, measured, analyzed, revised, and provide information (data) that can be recorded. This process will lead us to answers (conclusions) to our questions or perhaps result in even more questions.

Our students come to us with a myriad of questions about everything; however, they lack the skills to use the inquiry process for problem solving to research the answers to their questions. Teachers must teach and model the inquiry process. Classrooms must provide an environment which encourages and values the learners’ questions and promotes the “I wonder” through daily activities.

Ken Rosenbaum  
K R Consulting Inc.

*The most beautiful thing we can experience is the mysterious. It is the source of all true art and science. He to whom this emotion is a stranger, who can no longer pause to wonder and stand rapt in awe, is as good as dead: his eyes are closed.*

Albert Einstein

# Science Process Skills

## Classifying

- Creates groups by using a single attribute.
- Creates groups and sub-groups by using a single attribute.

## Observing

- Describes objects' attributes.
- Describes changes in terms of actions.

## Communicating

- Expresses opinions.
- Explains using sense data.

## Questioning

- Raises uncertainty focusing on attributes of objects.
- Focuses on relationships, patterns, and events.

## Predicting

- Guesses based on observable fact.
- Guesses from minimal supporting evidence.
- Guesses based on cause and effect relationships.

## Interpreting Data

- Identifies a single pattern among objects within an experiment.
- Identifies multiple patterns among objects within an experiment.

## **Controlling Variables**

- Identifies and selects factors from variables which are to be held constant and those which are to be manipulated.

## **Designing Experiments**

- Collects data through trial and error.
- Identifies and controls variables.
- Tests questions.
- Interprets results in measurable terms.

**What is a scientist?**

**Where can I find a scientist?**

**What does a scientist do?**

# Inquiry Science

## Steps to Follow:

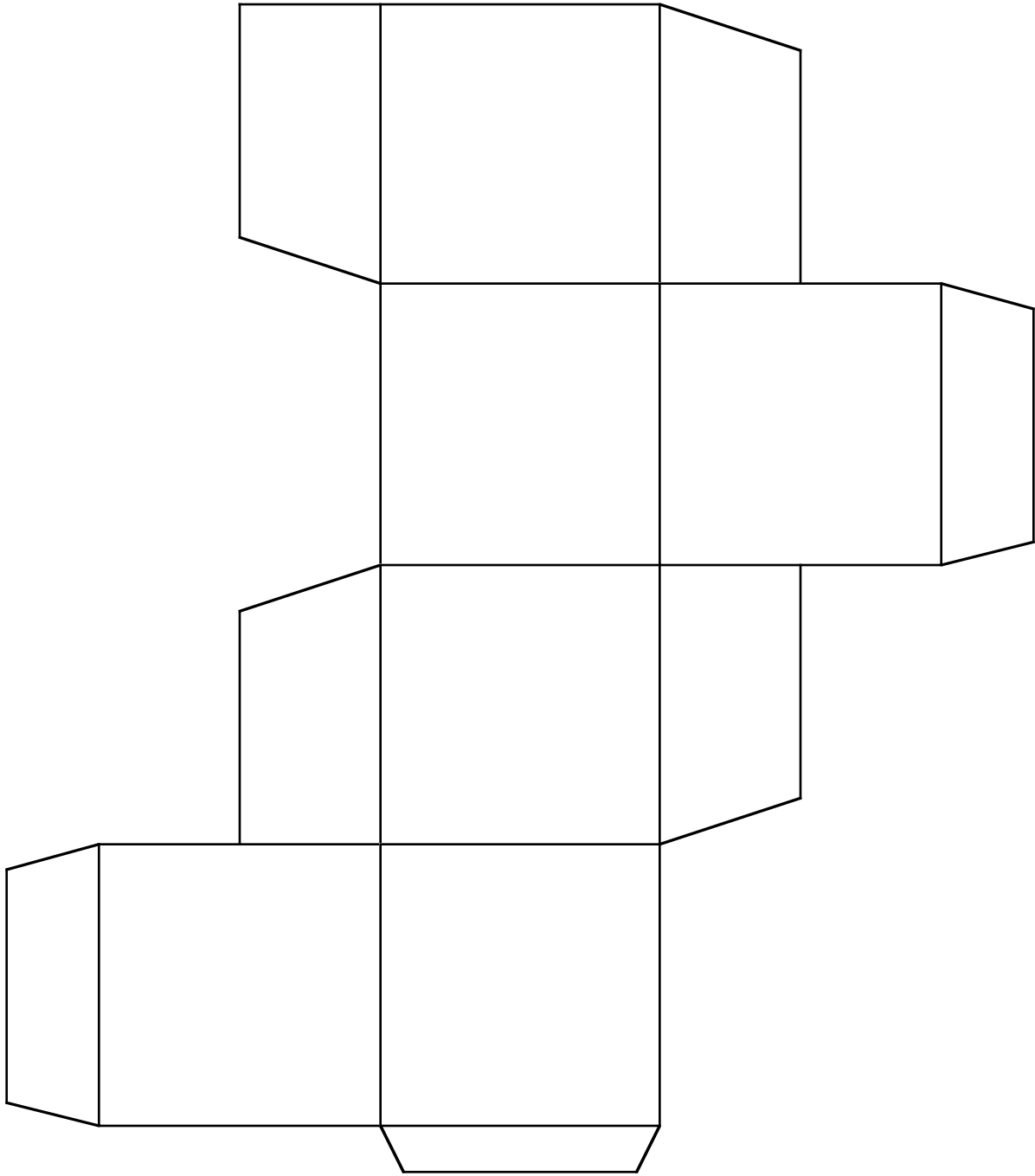
- **Exploration and discovery**
- **“I Wonder” questions**
- **Choosing one question**
- **Experimental design**
- **Conducting experiment**
- **Repeating experiment**
- **Presenting results**
- **Peer review and experimentation**

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# Question Cubes

<b>What</b>	<b>does</b>
<b>Why</b>	<b>can</b>
<b>How</b>	<b>should</b>
<b>When</b>	<b>might</b>
<b>Where</b>	<b>is</b>
<b>*</b>	<b>*</b>

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## Extensions for the Lesson on Air

- For a long term project or extended homework assignment, ask students if air takes up space. After recording their predictions to this question, ask them to design an experiment to prove their prediction. (*Students often simply blow up a bag or a balloon—point out that they have proven that carbon dioxide and water vapor being exhaled under pressure from the lungs takes up space—an indication that they did not research the true definition of air!*)
- Research how an air pump works.
- Why does a hot air balloon rise and fall?
- Challenge students to wonder about the “power of air”: heavy automobiles ride on tires filled with air, for example.
- Normal air pressure is 14.7 lbs. per square inch. The same amount is on your insides as your outside but . . . if you jump out of a space ship without a pressurized space suit, the pressure on your insides (14.7 lbs/sq. in.) will cause you to explode since there is no air pressure outside! What will happen if you go to the bottom of the ocean without a diver’s suit or submarine to protect you? (*You’ll implode.*)
- Using the above information, have students discover how suction cups work to hold up larger amounts of weight.



## Designing a Science Experiment

- **Research first.**
- **Gather materials.**
- **Keep records of procedures.**
- **Collect data/measure.**
- **Set up controls.**
- **Allow only *one* experimental variable.**
- **Include many trials—repeat the experiment.**
- **Share your data and results with others to support the conclusion:  
Data tables, graphs, charts.**

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# The Mers Are Coming!

“Poly” means many—“mer” means units. A polymer is a chemical made up of many units linked together. Eighty-six percent of today’s jobs in science are linked to polymer chemistry.

To make a polymer, follow these directions:

- Make a solution of white glue (Elmer’s) mixed with water in a 1:1 ratio.
- Make a Borax solution of 1/4 cup Borax and 1 liter of water. (**Caution:** When making the solution use adequate ventilation. Do not breath Borax powder since some people have an allergic reaction to it. **As always, wash hands thoroughly.**)
- Put two tablespoons ( six teaspoons) of glue solution in a small cup.
- Add two teaspoons of Borax solution.

Observe and record what happens as you stir the solution. Remove the product from the cup, knead it with your hands, and make observations about it. Tear it, bounce it, stretch it. This product may be stored in a plastic zip-type sandwich bag.

## Teacher Background Information

The white glue contains individual molecular chains of a polymer called polyvinyl alcohol. In the glue the molecules are able to slip and slide freely over one another. When you add the Borax, the chains are linked together to form a semi-solid material.

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## Process Skills with a Capital “P”

### Pretzel Phun

#### History

The pretzel originated in Germany. The word *pretzel* comes from the Latin word *pretiola*, which means “a small reward.” Southern European monks began making these German biscuits as a reward given to children who had learned their prayers. The pretzel’s shape is meant to resemble the praying children’s crossed arms.

#### Creative Writing Ideas

1. Before sharing the history of the pretzel, have students write of its origination. Encourage them to tell their audience when, where, who, and how the pretzel got its beginning.
2. Have students write their observations made in “Pretzel Watch” in narrative form. Perhaps they might describe a pretzel to an alien.
3. Encourage students to write pretzel poems.
4. Have students write their reactions to tasting pretzels.

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## Process Skills with a Capital “P”

### Pretzel Phacts

**Objective:** To systematically gather and quantify information.

**Materials:** Pretzels—75-100 pretzels of 5 different varieties  
Balances and weight sets

**Procedure:**

1. Divide class into 5 or 6 working groups and distribute 5 different varieties of pretzels to each group.
2. Have students create a name for each pretzel variety.
3. Have students predict which pretzel will have the most mass, the least, etc.
4. Record predictions.
5. Measure the mass of each variety of pretzel.
6. Have students complete a chart similar to the one below.
7. Compare findings with their predictions.
8. Compare findings with other groups.

**Process Skills:**

Collecting and interpreting data, predicting, observing, communicating, classifying, measuring

Pretzel Name	Mass in Grams			Average Mass
	#1	#2	#3	

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## Process Skills with a Capital “P”

### Pretzel Watch

**Objective:** To make accurate observations about pretzels.

**Materials:** Pretzels  
Hand lens  
Balances  
Rulers

**Procedure:**

1. Divide class into 5 or 6 groups and distribute 1 pretzel to each group.
2. Discuss using all senses in the observation of pretzels.
3. Have students measure, feel, smell, listen to, and look at the pretzels.
4. If you wish, you may have students taste the pretzels. Make sure they understand that tasting is not normally done in scientific observation because of potential danger.
5. Have students record as many findings as they can.
6. Collect pretzels from students and place in a container. Have 2 representatives from each group go to the container and identify “their” pretzel.

**Process Skills:**

Observing, measuring, using numbers, communicating

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## Process Skills with a Capital “P”

### Pretzel Pick

**Objective:** To compare and contrast attributes of pretzels.

**Materials:** Five varieties of pretzels (vary size, shape, etc.)

**Procedure:**

1. Divide class into 5 or 6 groups and distribute a variety of 5 pretzels to each group.
2. Have students place pretzels into 2 groups and name the attribute they used to divide the pretzels.
3. Have students place pretzels in 3 groups and name the attribute used.
4. Have class determine which group came up with the most original attribute.

**Process Skills:**

Classifying, observing, communicating, using numbers

**Objective:** To develop an understanding of the relationships of shapes found in objects.

**Materials:** Variety of pretzels  
Paper and pencil

**Procedure:**

1. Distribute a variety of pretzels to every two students.
2. Have students count the number of shapes they can find in their pretzels.
3. Have students construct additional shapes from their pretzels.
4. Have students share their findings with the class.

**Process Skills:**

Recognizing space/time relationship, observing, classifying, communicating, using numbers

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# Attributes

- **Divide the pretzels into two groups.**
- **What attribute did you use?**
- **Divide the pretzels into three groups.**
- **What attribute did you use?**

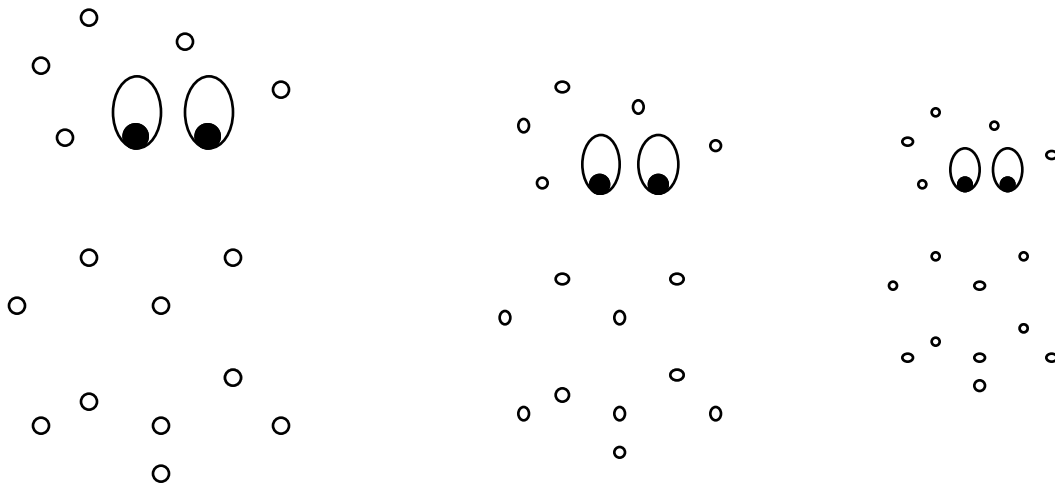
<b>Pretzel Name</b>	<b>Predicted Mass</b>	<b>Actual Mass</b>

# Mystery of George's Potatoes

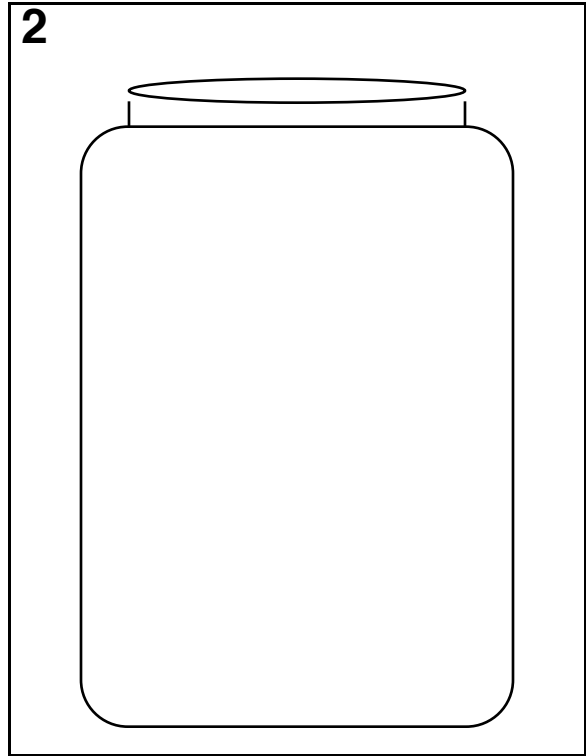
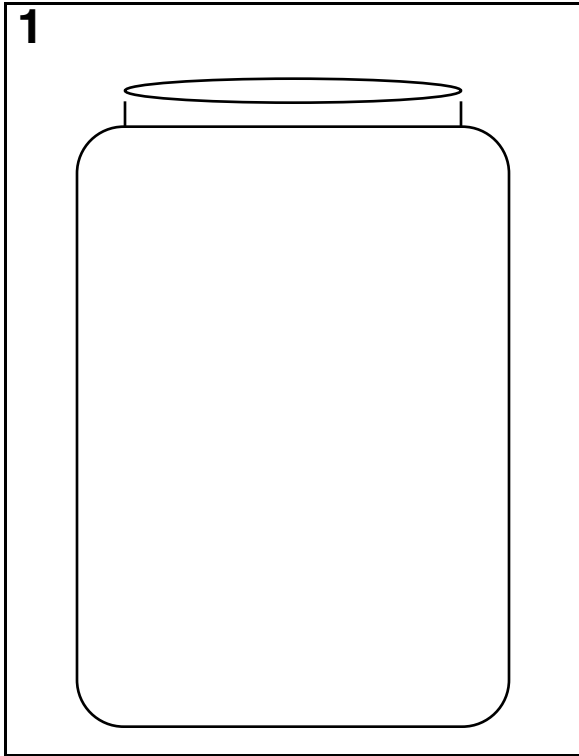
Sam Colson and George Lewis had been growing potatoes on neighboring farms for several years. During harvest time, they spent long hours sorting the potatoes by size as required by the local farmers market.

But this year Sam noticed that George was not sorting his potatoes before driving to the market. The next time Sam saw George loading his potatoes, he asked if George was selling his potatoes to a different market. George said no. Sam was puzzled. He wondered why he had to sort his potatoes before selling them and George didn't. George replied that he was sorting his potatoes on the way to the market.

**How did George sort the potatoes while driving to the market?**



# Mystery of George's Potatoes



**AHA!**

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# The Mystery of George's Potatoes

## Objectives:

1. To recognize that all matter occupies space.
2. To observe that two pieces of matter cannot occupy the same space at the same time.
3. To provide experience in problem solving.

## Background:

All matter occupies space. No two pieces of matter can occupy the same space at the same time. Often there are small spaces between the objects. The smaller objects are, the closer together they fit. (The smaller the objects, the smaller the spaces between them.) In this activity, as the container is shaken, settling takes place. The grains of rice settle fitting closer together. This forces the larger object, the ball, to the top.

## Materials:

large clear wide mouth jar  
raw rice (or popcorn)  
colored ball that will fit in the jar  
Student Activity Page

## Brainstorming:

Discuss the story with the students. On the board, list all ideas and possible solutions generated by the students. Discuss how some of the ideas could be tested. Below is one procedure that can be used to solve the problem.

## Procedure:

1. Put the ball in the jar and pour in enough rice (or popcorn) to cover the ball. (Make sure the ball is covered but the jar is not more than about  $\frac{2}{3}$  full.)
2. Give students copies of the Student Activity Page. Have them complete the drawing in Section 1 to show the position of the ball and the rice.
3. Tell students that the rice represents the small potatoes in George's truck and the ball represents a large potato. (The jar would simulate the bed of a truck.)
4. Remind students that George's truck traveled on rough country roads between his farm and the market. Tell them you are going to shake the jar to simulate the motion of the truck. Have them observe what happens to the "potatoes."
5. Have students complete the drawing in Section 2 of the Student Activity Page to show the outcome.

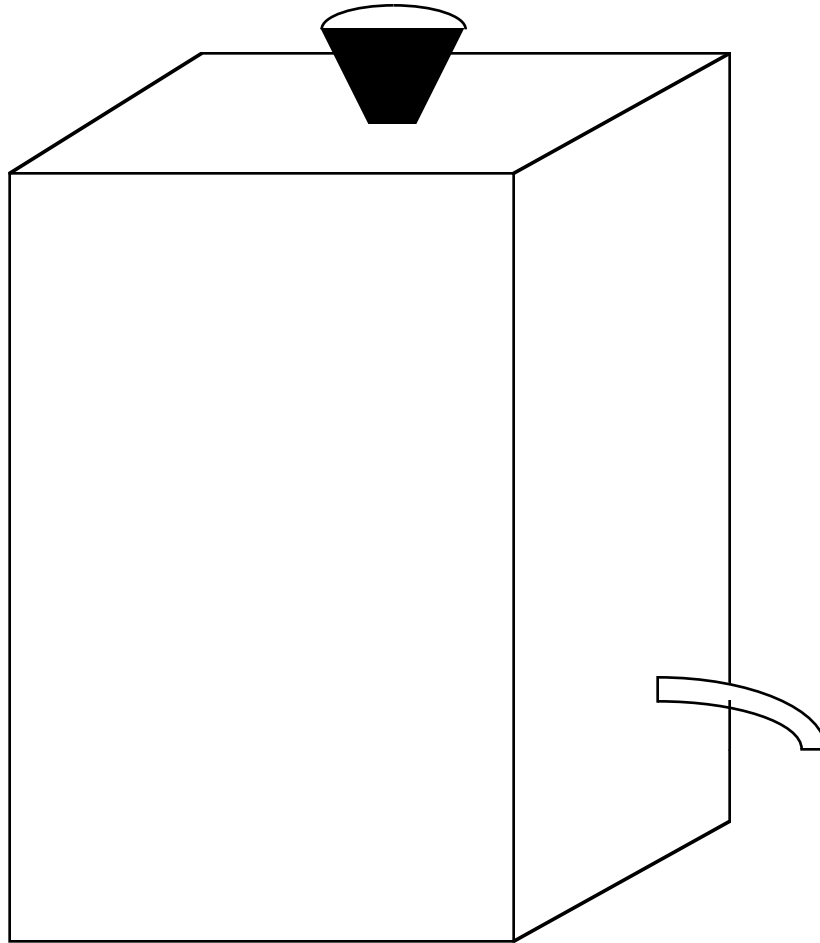
**AHA!**

How did the motion of the truck allow George to sort his potatoes? Have students write their responses in the AHA! section of the Student Activity Page.

**Extension Activities:**

1. Ask students to bring potatoes from home. Place the potatoes in a cardboard box and shake to simulate the ride in George's truck. (Be sure potatoes are several layers deep.)
2. Ask students how this process could help them find the Brazil nuts in a container of mixed nuts.
3. Experiment with other objects: dried beans, dried macaroni, puffed rice cereal, and buttons. Vary the size and weight of the large object.

Name \_\_\_\_\_



# **Inquiry Science Tips to Remember**

- **Start with hands-on activity for exploration and discovery.**
- **Learners ask “I wonder” questions.**
- **Learners design experiments to investigate their own questions.**
- **Learners measure, collect, and record data and display data.**
- **Learners present their results for Peer Review.**
- **Peers review and question.**
- **Peers repeat the experiment to verify results.**

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