



<b>Title:</b> What is Porous, Exactly?			
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<b>Course:</b> Science, Language Arts			<b>Duration:</b> 3 days
<b>Grade Level:</b> 2			
<b>Objective:</b> Students will learn that some rocks are <b>porous</b> , which allows oil to collect in the rock.			
<b>Summary of Lesson:</b> The students will predict and experiment using 9 different types of rocks to discover which rocks are porous and which ones are not porous. Through the understanding of the key concept, the students will discover that oil and natural gas are absorbed in the rock and become trapped inside the pores.			
<b>Standards: Arkansas State Frameworks</b>			
<b>Subject:</b>	<b>Grade Level(s):</b>	<b>Code:</b>	<b>Standard:</b>
Science	2	2-PS1-1	Plan and conduct an investigation to describe and classify different kinds of materials by their observable properties. [Clarification Statement: Observations could include color, texture, hardness, and flexibility. Patterns could include the similar properties that different materials share.]
Language Arts	2	SL.2.1	Participate in collaborative conversations with diverse partners about Grade 2 topics and texts with peers and adults in small and larger groups.
		SL.2.4	Tell a story or recount an experience with appropriate facts and relevant, descriptive details, speaking audibly in coherent sentences.
<b>Teacher Enhancement and Support Systems:</b> 1a: Demonstrating knowledge of content and pedagogy, 1c: Setting instructional outcomes, 1d: Demonstrating knowledge of resources, 1e: Designing coherent instruction, 1f: Designing student assessments, 3b: Using questioning/prompts and discussion, 3c: Engaging students in learning, 3d: Using assessment in instruction,			
<b>Instructional Strategies and Practices:</b> Checking for understanding, t-chart, grouping students, hands-on activities, cooperative learning groups, probing questions, modeling, student presentations, partners, experimenting,			



**Bloom's Level(s):** *(Highest Only)*

Creating

**Materials and Resources:**

**Day 1**

- Sprout and Grow Window or clear cup with marbles  
*(Sprout and Grow Window is available at several online sites)*
- 100 ml beaker with water
- Tray to catch water from cup and marbles
- Porous and non-porous rocks

**Day 2:**

- 5 rocks collected by each group (3 per student)
- Additional samples of sedimentary rock (i.e. Limestone, sandstone, shale and granite) may be purchased from several on-line sources; or contact **Arkansas Geological Survey, 3815 W Roosevelt Rd, Little Rock, AR 72204, Phone:(501) 296-1877**
- 1 eyedropper or pipette per group
- Markers
- Water
- Paper towels

**Day 3:**

- 1 package of chocolate cream cookies
- 1 gallon of vanilla ice cream
- Squeeze fudge ice cream topping or drink mix
- 1 bag of crushed peanuts
- 1 can of whipped cream
- Sprinkles
- Graded cylinder
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**Formative Assessment:**

Exploration and Prediction Worksheets (See **Student Worksheets**)

- Seeping Stones Prediction/Result Chart
- Sort By Porous and Non-porous
- Porous/Non-porous Foods We Eat
- LaPorous Ice Cream Sundae

**Teaching Notes:**

**Lesson Preparations**

1. Collect materials for each day from the lists provided.
2. Make copies of the lab sheets, one for each student  
See **Student Worksheet: Exploration and Prediction Charts**



- Seeping Stones Prediction/Result Chart
  - Porous/Non-porous Foods We Eat
  - Sort By Porous and Non-porous
  - LaPorous Ice Cream Sundae
3. Read through the “Teacher Background” section below prior to the lesson.
  4. Before the lesson begins, take the students outside to find 3 rocks each. Make sure that you put a size limit on the rocks so that they are not too small or too big.
  5. If you do not have accounts already for Brainpop.com or BrainpopJr.com, ask your librarian to purchase the license.

### **Vocabulary Words**

**Oil traps** - places where oil collects underground after seeping up through the surrounding rocks.

**Permeability** - the ability of liquids and gases to move through pore spaces in rocks

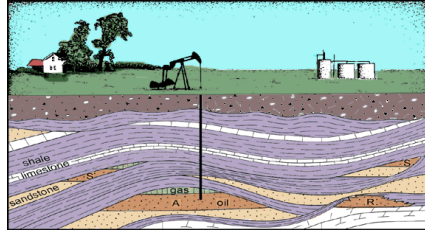
**Porous** - having pore spaces

**Porosity** - the ability of a liquid and/or gas to collect in pores of rocks much like water collects in a sponge.

### **Teacher Background:**

Some sedimentary rocks are **porous**, like a sponge. Tiny particles of sand are held together with rock “cement.” Pressure, time and sediments create this natural type of “cement.” Oil and natural gas form from decayed plant and animal material. Over time, the many layers of sand and sediments are compacted into sedimentary rock. Tiny spaces, or pores, exist between the particles that enable the rock to hold a liquid. Oil and natural gas become trapped inside the pores. Many pores may be connected to form a pore passage. Rocks that contain pores and pore passages are identified as **porous** and **permeable**. **Permeability** is the ability of liquids and gases to move through pore spaces in rocks. A rock may be porous, but if the pore spaces are not connected together, the liquids will not be able to pass through the rocks. Through drilling and pumping, oil and natural gas are extracted from the inside of porous rock. This is contrary to the belief that oil is formed in puddles or pools underground.

## Student Activity:



### Day 1:

#### Engagement

##### Materials:

- Sprout and Grow Window or clear cup with marbles. The Sprout and Grow Window is available from several suppliers on the internet.
- 100 ml beaker with water
- Tray to catch water from cup and marbles
- Porous and non-porous rocks

Use a Sprout and Grow Window (shown to the right) or clear plastic cup full of marbles or rocks.

Pose the following questions:

1. If water is added to this container, how much water do you predict it will hold?
  - Measure 100ml of water in a graduated cylinder.
  - Start by pouring 20ml of the water into the cup.
  - After observing the cup, have students decide how much water should be added.
  - Continue this procedure until the cup is full of water (a tray may be needed for spills).



How does this demonstrate porosity? Where does the water collect?

**Possible answers: The water soaks into the soil (Sprout and Grow Window) or moves into the spaces between the marbles (cup with marbles). The water collects in the small spaces within the soil (or between the marbles.)**

2. Do you think rocks could store things other than water?

**Possible answer: Under the right conditions, pores inside rocks may also hold oil and natural gas. The more porous the rock, the more oil and natural gas it can hold.**

#### Exploration

1. Divide the students into groups of four. Assign each student a job from the list below.
  - Recorder: the student who writes down the information from the experiment
  - Reporter: the student who presents their group's findings to the class
  - Material Manager: the student who gathers and puts away the materials for the experiment
  - Facilitator: the student who oversees the experiment and ensures their group stays on task.



2. Teacher says: "Today we are going to learn that some rocks are **porous**. They have pores that allow oil to collect in the rocks." Show a rock that is porous and one that is not porous.
3. Let the students begin their exploration and prediction charts. Once the students have completed the chart, have the students, as a group, present the prediction charts: Pose the question: "Will the rock drink the water?"
4. After the presentations, discuss with the students again the concept of porosity and the rocks ability to hold a liquid and/or gas.
5. Show YouTube clips relating to **porosity**. Search the internet for a video that fits your grade level. Search with key words: porosity; porosity in rocks; porosity in oil and gas formation. Some examples are:  
<http://www.youtube.com/watch?v=trAsnAC9D6k>  
<https://www.youtube.com/watch?v=5nLOLEgJd3A>  
[https://www.youtube.com/watch?v=j\\_Vns8uZ1G0](https://www.youtube.com/watch?v=j_Vns8uZ1G0)

## **Day 2: Seeping Stones Experiment**

### **Materials**

- 5 rocks collected by each group
- Additional samples of sedimentary rock (i.e., limestone, sandstone, shale and granite)
- 1 eyedropper or pipette
- Markers
- Water
- Paper towels
- Student Handout: **Exploration and Prediction Charts**

### **Instructions**

1. Place the rocks that were collected outside in the middle of table. As a group, decide on the best 5 rocks and leave those in the middle of table. Place the rocks that will not be used in a container at the materials workstation.
2. The Material Manager should collect the following rocks from the materials workstation: sandstone, limestone, shale and granite. Collect paper towels, a cup of water, pipette, and a marker. The group should now have a total of 9 rocks and all the materials needed to begin the experiment.
3. Using the marker, place a number (1-5) on the rocks that were found outside. This is so students can identify the rocks throughout the experiment.
4. Fill in the group's predictions on the Seeping Stones Prediction/Result Chart (**See Student Worksheet.**) Predict: what they think will happen when five drops of water are dropped on each rock. Use a ☺ if they believe the rock will absorb water; use a ☹ if they believe the rock will not absorb water.
5. Conduct the experiment: place the rocks on the paper towels; carefully drop 5 drops of water on each rock.



### After Experiment

1. Sort the rocks on the **Student Worksheet** “Sort by Porous and Non-porous” On the smiley face place the rocks that “drank” or absorbed the water and place a ☺ beside that number in the Result section of the worksheet. Place the ones that did not “drink” the water on the frowny face and place a ☹ beside that number in the Result section.
2. With a buddy, the students will complete the following:
  - Partner 1: Ask and answer a question about the experiment
  - Partner 2: Decide if the answer is correct using a thumbs up or thumbs down.
  - Partner 1: Defend your answer by thinking about what you have learned today.
  - Partner 2: Ask and answer a question. Continue until time is called by the teacher.

### Day 3: Elaboration

#### Materials

- 1 package of chocolate cream cookies
  - 1 gallon of vanilla ice cream
  - Squeeze fudge ice cream topping or drink mix
  - 1 bag of crushed peanuts (**substitute crushed graham crackers if there is a danger of peanut allergies**)
  - 1 can of whipped cream
  - Sprinkles
  - Graded cylinder or tall clear cups
1. Have students work in groups of four to construct a t-chart (See **Student Worksheet**) of foods they eat that are porous and nonporous. Non-writers as well as kindergarten students may look in cooking magazines for pictures.

#### **Example:**

Porous	Nonporous
Cake	Flavored gelatin
Cornbread	Hard Candy
Rice Cake	Chocolate Bar

2. Using the ingredients from Day 3 materials list, have students design a LaPorous Ice Cream Sundae that models an oil well and soil layers. (See **Student Worksheet**)
  - As students are constructing the LaPorous Sundae discuss why the ingredients represent the layers.
  - Think of another ingredient that could also represent each layer and list these on the t-chart begun earlier.







Student Handouts: See web site for a printable copy:

<http://www.arkansasenergyrocks.com/educators/lesson-plans-k-8/>





## Exploration and Prediction Charts

Names: \_\_\_\_\_  
\_\_\_\_\_

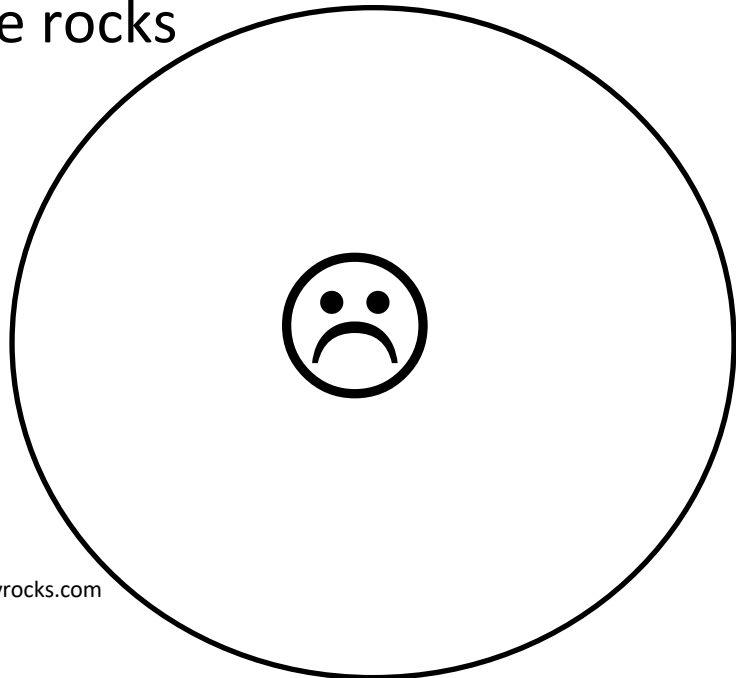
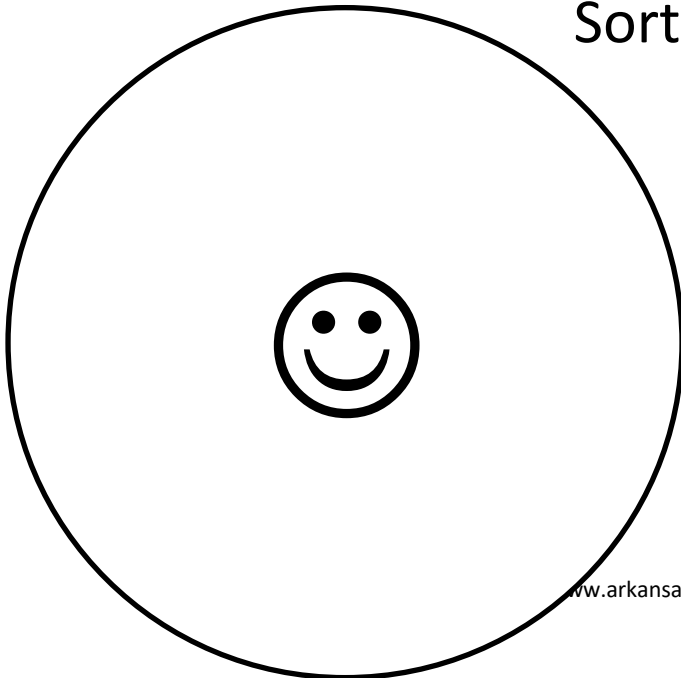
### Predict: Will the Rock Drink the Water?

	☺	☹
Rock 1		
Rock 2		
Rock 3		
Rock 4		
Rock 5		
Sandstone 		
Limestone 		
Shale 		
Granite 		

## Did the Rock Drink the Water?

	☺	☹
Rock 1		
Rock 2		
Rock 3		
Rock 4		
Rock 5		
Sandstone 		
Limestone 		
Shale 		
Granite 		

Sort the rocks







1. Construct a t-chart (provided below) of foods you eat that are porous and nonporous.  
**(Teacher note: Non-writers may look in cooking magazines for pictures.)**

**Example:**

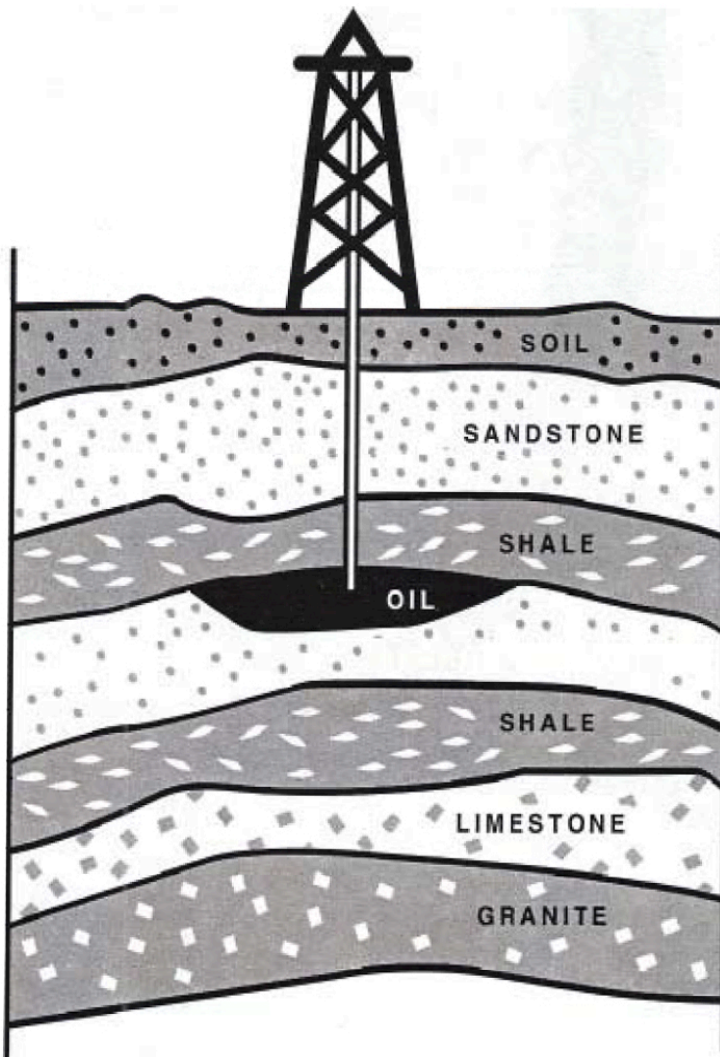
Porous	Nonporous
Cake Cornbread Rice Cake	Flavored gelatin Hard Candy Chocolate Bar

## T-chart

Porous	Non-porous
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2. Design a LaPorous Sundae using the provided ingredients:

- As you and your partners are constructing the Sundae discuss why the ingredients represent the layers.
- Think of another ingredient that would also represent each layer.



### LaPorous Sundae

- Fudge Topping = Oil
- Ice Cream = Limestone
- Chocolate cream cookies = Dolomite
- Crushed peanuts = Sand
- Straw = Drill
- Whipped Cream = Shale
- Sprinkles = Gravel