



Earth Matters

Overview: Classification activities that will lead students from simple sorting of familiar objects to classifying materials into liquids, gases, and solids.

Target Grade Level: K-2

Estimated Duration: 3 40-minute sessions

Learning Goals: Students will be able to...

- classify paperclips of different sizes, colors, and materials into categories chosen by student groups.
- compare student group classification schemes using simple bar graphs.
- classify objects brought from home into the categories of “natural” or “human-made”.
- classify “natural” objects into liquids, gases, solids, and combinations.

Standards Addressed:

Benchmarks (AAAS, 1993)

The Physical Setting, 4B: The Earth

The Mathematical World, 9A: Numbers

National Science Education Standards (NRC, 1996)

Earth & Space Science, Standard D: Properties of Earth materials

Science & Technology, Standard E: Abilities to distinguish between natural objects and objects made by humans

Principles and Standards for School Mathematics (NCTM, 2000)

Algebra Standard

Data Analysis and Probability

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Background:

Sorting or grouping objects by shared characteristics is a precursor to more elaborate classification schemes that will be used in later grades. In the early years of school, however, a more loosely structured approach fosters inquiry and engages the students' natural curiosity.

Students have been informally learning about the materials that make up the Earth through experience. They have likely played in the sand or dirt, seen rocks of all shapes and sizes, felt water of many temperatures and from many sources, and breathed in the gases that make up our atmosphere. Now they will be introduced to the terms used to describe these materials that make up our Earth—solids, liquids, and gases.

Often solids, liquids, and gases are referred to as the *states* or *phases of matter*. For example, water occurs naturally in three phases that depend on temperature and pressure; it occurs as a liquid, as a solid in the form of ice, and as a gas in the form of water vapor. Students will not learn about these technical definitions of the states or phases of matter, and nor will they learn about atoms in this lesson. These concepts will be introduced in later grades. Instead, this lesson focuses on comparing materials that represent these phases of matter and occur naturally on Earth. Then the activity will end by asking students to think about the materials that make up other planets and dwarf planets, such as the distant Pluto. How might matter on other planets compare with that on Earth, and how do we know?

The following general definitions may be useful when introducing these terms:



Solids:

- They keep their shape
- They do not flow



Liquids:

- They do not keep their shape; instead they take the shape of the container they are in
- They flow



Gases:

- They do not keep their shape; they completely fill the container they are in
- They flow

Natural: present in or produced by nature.

Human-made: made by humans rather than occurring in nature; synthetic.

Materials:

Day 1

- buttons of various colors, sizes, and number of holes (about 15 – 20 total)
- paperclips (or another object that could be sorted, such as Legos®)
 - plastic in different colors (about 100)
 - metal in different sizes (about 100)
 - different shapes, if desired (about 100)
- sticky (Post-it® style) note pad
- re-sealable (Ziploc® style) plastic bags (sandwich size, 1 per student)
- copies of **Parent/Guardian Information** page (cut in half, classroom set)

Day 2

- magnifying glasses (1 per student)
- rulers (1 per student)
- other measuring or observation tools if desired
- masking tape
- permanent marker
- copies of **I brought...** Science Journal Page (1 per student)
- copy of **Natural** label (1)
- copy of **Human-made** label (1)
- box in which to store items in re-sealable plastic bags brought in by students

Day 3

- book: *What is the World Made of?* by Kathleen Weidner Zoehfeld (ISBN: 0064451631; \$4.99 new or \$2.50 used)
- baggie with water
- baggie with an ice cube
- balloon with air (non-latex if students have allergies (mylar, latex free glove, etc.))
- balloon with helium (if possible)
- other examples of solids, liquids, and gases if desired
- copies of **Solids, Liquids, Gases, and Combination** Science Journal Page (1 per student)
- copy of **Solids** label (1)
- copy of **Liquids** label (1)
- copy of **Gases** label (1)
- copy of **Combination** label (1)
- copies of **I found...** Science Journal Page (1 per student)

Procedure, Day 1:

Generally speaking (summary)...

What the teacher will do, Day 1: The teacher will demonstrate how to classify objects by sorting buttons of different colors, sizes, and number of holes. Then he/she will divide the class into groups and distribute assorted paper clips to each group. The teacher will walk between groups, placing a sticky note with a one-word description on the group's table each time they sort the paper clips by a different characteristic. Before moving to the next group, he/she will recombine the paperclips into one pile. After

groups have sorted paperclips by three different characteristics, the teacher will lead a discussion using the sticky notes and a simple chart drawn on the board. Finally, he/she will distribute a re-sealable plastic bag with the **Parent/Guardian Instructions** half-sheet to each student, and assign them to bring an object from their yard or the playground to class for Day 2.

What the students will do, Day 1: After observing the teacher demonstration, student groups will classify assorted paperclips by characteristics of their choice. After sorting by one characteristic, they will raise their hands so the teacher can record the scheme chosen on a sticky note. They will then sort them by a different characteristic. After this process has been repeated three times for each group, the class will discuss the various characteristics by which the paper clips were sorted. During recess or after school, the students will collect items from the playground or their yards and place the items in a re-sealable plastic bag (provided). They will each bring the collected item to school the following day.

Advance Preparation, Day 1

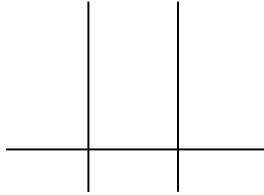
1. Assuming groups of 4 or 5 students, determine the number of groups and locate the appropriate amount of materials, as indicated in the **Materials** section.
2. Combine assorted paper clips (or other objects) so that each group of 4 or 5 students will have about 15 of each kind (15 plastic in different colors, 15 metal of different sizes, etc.)
3. Make a half-classroom set of copies of the **Parent/Guardian Information** page and cut in half. Place 1 half-page in each re-sealable plastic bag.

In-class Procedure, Day 1

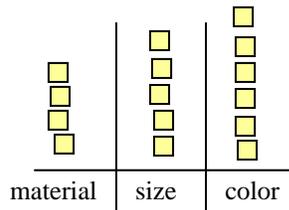
1. Introduce the class to the term *classify* and its definition. **Classify:** to arrange or organize according to class or category; to sort. List several classes or categories by which items can be sorted, including size, color, material, use, weight, etc.
2. Model for the students how to classify or sort any object using buttons. Demonstrate sorting them into small piles by size, number of holes in the button, colors, etc. Explain to students that they will do a similar activity using paper clips.
3. Divide the class into groups of 4 or 5 students and ask them to sort the paper clips you provide them into different categories that they create. After the group has sorted the paper clips by a characteristic of their choosing and they all agree on the outcome, they should raise their hands. You will go to that group and ask them how they classified or sorted the paperclips and make sure the paper clips are sorted properly. NOTE: if groups of 4 are too large, divide class into smaller groups.
4. Write the classification scheme and the number of categories on a sticky note and attach it to the desk. Examples of what you might write include: “material, 2” if they classified them into two piles of metal and plastic; “size, 3” if they sorted them into piles of small, medium, large paperclips; “color, 3” for three groups, red, orange, yellow; etc. Before moving to the next group, be sure to recombine all of the paper clips into one pile and ask the group to sort by a different characteristic. Repeat this process until each group has sorted the paper clips 3 different ways. **Note:** Ask students to refrain from hooking the paperclips

together and remind them they will have to take them apart to classify by a different characteristic.

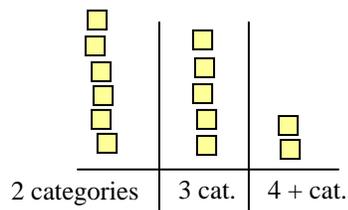
- On the board, draw a large inverted table with three columns and two rows as follows:



Label the column headings with the common classification schemes that you observed. For example: label the columns as **material** (metal and plastic), **color**, and **size**. Then go to each group and, as a class, talk about the three ways they classified the paperclips. If any match the categories in the table, place that sticky note in the appropriate column. By placing one sticky note above another you create a basic bar graph. If some sticky notes don't fit in any of the categories, either add another column or stick them off to the side. Eventually, your table may look like this:



- Discuss the results as a class. Which classification did the most groups choose? And the least? Show students how displaying sticky notes one above another easily allows for comparison. How many groups chose to classify the paper clips by size? Were there some sticky notes that didn't fit in any of the categories? Should another category be added? You can incorporate as many math questions as you would like, including: How many groups chose to classify by material? By color? How many total sticky notes are there? etc.
- Move the sticky notes off to the side and create different column headings. Recall on your sticky notes you recorded the classification scheme along with the number of categories (color; 4 categories (e.g. blue, red, orange, yellow)). So now graph the results using the number of categories. For example: **2 categories** (such as small and large; metal and plastic), **3 categories** (such as small, medium, large); **4 or more categories** (red, yellow, orange, blue, and purple). As a class discuss above which heading each sticky note should be placed, and place it accordingly. Again, discuss the results and incorporate simple graphing and math by placing the sticky notes one above the other and asking for interpretation from the class.



- Distribute sandwich sized re-sealable plastic bags to the class (1 per student) containing the **Parent/Guardian Information** half-sheet (NOTE: *see this sheet*)

for further instructions). Explain that they are to find an object in the playground or their yard that will fit into the plastic bag and bring it to class the next day. If students are able to collect items on the playground they can leave them at school for use the next day. Ask students to put their name on the bag using a permanent marker or by writing their name on a sticker and attaching it to the bag.

Procedure, Day 2:

Generally speaking (summary)...

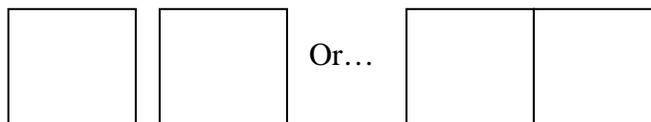
What the teacher will do, Day 2: The teacher will divide students into groups again. The teacher will facilitate as the students put their bags (containing an object from the playground or home) on the table in front of them, and the bags will remain in place as the students rotate around and explore the items using magnifying glasses, rulers, or other tools if desired. First the teacher will ask the students to rotate within their own group, then group 1 will move to where group 2 was, and group 2 will move to where group 3 was, etc., while the bags stay in place. After all students have observed all of the objects in bags, the teacher will ask the class to return to their seats.

Once seated, the teacher will lead a discussion of human-made versus natural materials. Then he/she will ask the students to bring their items in a bag to squares on the ground and individually the students will place their bag in the appropriate square (“human-made” or “natural”) and they will explain to the class why they believe their item belongs in that square. Finally, the teacher will offer guidance and answer questions as the students independently complete their **I brought...** Science Journal pages. Keep the items in bags handy for Day 3. *Note: the Science Journal pages can be used for assessment if desired.*

What the students will do, Day 2: Each student will label the re-sealable bag with his/her name, and place it on the table in front of him/her. When prompted by the teacher, the students will rotate within their own group, observing all of the items in bags, and then whole groups will move to a different table and rotate through the items in bags at that table. After all students have observed all of the objects, they will gather around the squares on the floor labeled with “natural” and “human-made”. Then they will classify their item as either natural or human-made by placing the bag (including the collected item) into the appropriate square marked on the floor while explaining to the rest of the class why they believe it should be classified as natural or human-made. Finally, they will independently complete the **I brought...** Science Journal pages.

Advance Preparation, Day 2

1. Place 4 or 5 magnifying glasses, rulers, etc. on each table (depending on the size of the group—1 per student)
2. Using masking tape, make two squares on the ground that are each about 4 feet by 4 feet, similar to one of the following:



Print out the Natural and Human-Made labels and place one in each square.



In-class Procedure, Day 2

1. Arrange students in groups of 4 or 5 and ask them to place their bags with the collected item inside it on the table in front of them. Upon your signal, they are to move to the chair to their right while leaving the bags in place (i.e., the students move, the bags remain in place). They will explore the item in the bag in front of them using the materials provided (magnifying glass, ruler, etc.). After your signal (about 30 seconds), they are to move to the next chair to their right and inspect the item in the bag at that location.
2. Continue in this manner until they are back to their own seats, and then ask the groups to move to a neighboring table in a round-robin fashion (group at table 1 moves to table 2, group at table 2 moves to table 3, etc.). Note: if one group has fewer students, you will need to hold a place at that table with an empty chair and supply a re-sealable bag with an item you collected to coordinate the timing and accommodate the larger groups as they visit that table.
3. Once students have returned to their own seats, ask them to bring their item in the bag and gather around the Natural and Human-Made squares. One at a time, students should:
 - a. say what they brought
 - b. place it in the appropriate square (Natural or the Human-Made), and
 - c. explain why they think it is natural or human-madeFacilitate discussion as needed.
4. Finally, students will return to their seats and complete the **I brought...** Science Journal page. Some students may need help filling in the blank. You could write several of the words on the board for them and they could copy those words into the blank on their Science Journal page, or you may need to facilitate this journal activity as a class if most students are not yet able to copy from the board. Also ask them to draw a picture of their item in the appropriate square (natural or human-made). If time permits, you could also ask them to draw their favorite item from the round-robin in the appropriate square. *Collect this page for assessment if desired.*

Procedure, Day 3:

Generally speaking (summary)...

What the teacher will do, Day 3: The teacher will begin by reading the book *What is the World Made of?* Then the teacher will help students further classify their items (in bags) from Day 2 by individually placing them into one of the 4 squares on the ground labeled as “solids”, “liquids”, “gases”, or “combination.” Then the teacher will add items including an ice cube in a bag, water in a bag, and a balloon with air (and helium, if possible) to the squares. The teacher will help students classify some objects that are a combination of liquids, solids, and gases. For example, mud is a mixture of solids and liquids.

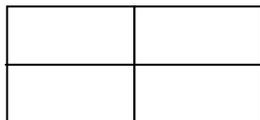
The teacher will lead a discussion about other materials from which the Earth is made that were not brought to class. The teacher will then offer help as students complete their **Solids, Liquids, Gases, and Combination** Science Journal pages, *which*

can be used for assessment if desired. As an additional assessment, teachers can assign as homework the **I found...** Student Journal page.

What the students will do, Day 3: They will listen to the story *What is the World Made of?* Then they will re-classify their item (in a bag) as a solid, liquid, gas, or combination by placing it in the appropriate square on the ground. Again, they will tell the class why they feel that is the correct classification. They will discuss other items not brought in that are examples of what the Earth is made of. The students will participate in a discussion about what other planets might be made of and how we learn about the materials on other planets. Students will independently draw or write the names of two items in the **Solids, Liquids, Gases, and Combination** science journal pages and circle one item that they believe could be observed on the dwarf planet Pluto by the New Horizons spacecraft. As homework (*assessment*), students will complete their **I found...** Student Journal pages.

Advance Preparation, Day 3

1. Convert the 2 squares on the floor into 4 by placing another piece of tape across the center as follows:



2. Print the **Solids, Liquids, Gases, and Combination** labels, and place one in each square.
3. Bring in an ice cube in a re-sealable plastic bag, water in a bag, a balloon with air, and a helium balloon if possible.
4. Make copies of the **Solids, Liquids, Gases, and Combination** and **I found...** Student Journal pages.

In-class Procedure, Day 3

1. Begin by reading aloud the book *What is the World Made of?* by Kathleen Weidner Zoehfeld. Then ask students to bring their item in a bag from Day 2 to the squares on the ground labeled with Solids, Liquids, Gases, and Combination.
2. As in Day 2, one at a time, students should:
 - say what they brought
 - place it in the appropriate square (Solid, Liquid, Gas, or Combination), and
 - explain why they think it belongs thereFacilitate discussion as needed, especially about “Combination” items like mud or chicken noodle soup. Ask what other items could be included in each category and why.
3. After they are finished, ask students in which square you should place your own items (ice, water, and air (and helium, if desired)) and why. Ask students to remove all of the items that are not materials that the Earth is made of. Discuss other items that were not brought in, but that could be added to these categories and are materials that the Earth is made of.
4. Then lead a discussion about what materials might be found on other planets. Begin with a simple question about will they be “natural” or “human-made”?

Then ask about which solids, liquids, and gases, if any, might be found on other planets. Will they be the same as or different from those found on Earth?

5. Allow students to independently complete their **Solids, Liquids, Gases, and Combination** science journal pages. Ask them to draw or write the name of at least two objects for each category. You can allow them to include items that were not brought to class, but talked about during the discussion if desired. Then ask them to circle at least one item they believe could be observed on the dwarf planet Pluto by the New Horizons spacecraft. You may wish to write the name of several objects on the board so that students can copy them. *You can collect the science journal page for assessment if desired.*
6. As homework, assign students to complete the **I found...** Science Journal page. Explain to students that they should find examples at home of a 'solid,' 'liquid,' 'gas,' and 'combination.' They should either write the name of or draw the example for each object/material in the appropriate square on the Science Journal page. *Explain that you will be collecting and grading the Science Journal pages.*

Extensions and Adaptations:

- Reveal the phenomenon of phase changes by determining the mass of the ice cube and water in bags and write the mass on the bag with a permanent marker. Then place the water in the freezer and the ice cube in a sunny or warm location. Check on the bags at the end of class or the following day. Determine their mass again to show they have not changed mass, but they have changed from ice to water, and from water to ice.
- Also reveal a phase change by placing two containers with equal amounts of water next to each other. Place a lid or secure cover over one and leave one uncovered. Have students determine the height of the water or mass in each container every day and graph or record their results over time.
- If there are visually impaired students in the class, ask all students to describe their item in a bag before placing it in the “natural” or “human-made” squares as well as in the “solids”, “liquids”, “gases”, or “combination” squares.
- To simplify the activity for physically impaired students, during the Day 1 round-robin the students could remain in their seats and pass the items in bags to their right upon your announcement. They would still need to switch to another table between rounds, but this would eliminate the need to move every few minutes. Or, the teacher could put the bags in bins and move them from table to table, however this would take more time.
- It might be fun to introduce the idea of a ‘combination’ item by making mud in front of the class. Present water and sand in two separate containers and talk about how you have a liquid and a solid. Then combine them and you have a ‘combination’!
- Have students create matter collages using pictures of solids, liquids, gases, and combinations that they cut out from magazines.
- Discuss what the Mars Exploration Rover Mission and other missions have learned about the materials that make up Mars. (<http://marsrovers.nasa.gov/home/index.html>). How do these materials compare with those on Earth? Then discuss the fact that we don’t know nearly as much about the materials on Pluto, which is why we have to send a spacecraft there. What will the New Horizons spacecraft see on Pluto? (<http://pluto.jhuapl.edu/>).
- Read “*The Planets in our Solar System*” by Franklyn M. Branley (ISBN: 0064451789; also part of the ‘Let’s-Read-and-Find-Out Science’ series.

Resources and References:

- Zoehfeld, K. W. 1998. *What is the World Made of?* Harper Collins: New York.
- Branley, F. M. 1998. *The Planets in our Solar System* Harper Collins: New York.
- Driver, R., E. Guesne, & A. Tiberghien. 2000. *Children’s Ideas in Science*. Open University Press: Philadelphia.
- The New Horizons website: <http://pluto.jhuapl.edu/>
- For phase change activities and ideas: http://ksnn.larc.nasa.gov/k2/s_statesMatter.html

Standards:

National Science Education Standards (NRC, 1996)

Content Standards: K-4

Earth and Space Science, CONTENT STANDARD D:

- Properties of Earth materials

Science and Technology, CONTENT STANDARD E:

- Abilities to distinguish between natural objects and objects made by humans

Benchmarks (AAAS, 1993)

Chapter 4: The Physical Setting

4B: The Earth

Grades K-2

- Water can be a liquid or a solid and can go back and forth from one form to the other. If water is turned into ice and then the ice is allowed to melt, the amount of water is the same as it was before freezing.

Chapter 9: The Mathematical World

9A: Numbers

Grades K-2

- Simple graphs can help to tell about observations.

Principles and Standards for School Mathematics (NCTM, 2000)

Algebra Standard

Grades Pre-K-2

- Sort, classify, and order objects by size, number, and other properties

Data Analysis and Probability

Grades Pre-K-2

- Sort and classify objects according to their attributes and organize data about the objects

Natural

Human-Made

My name: _____

I brought _____

Natural

Human-Made

Solids

Liquids

Grasses

Combination

My name: _____

Solids:

Liquids:

Gases:

Combination:

Look what I am doing in school!

I am learning about what the Earth is made of, and how these materials can be classified as solids, liquids, and gases.

Tomorrow in class we are going to sort or classify objects brought from home. We will first classify them as "natural" or "human-made" and then we will classify them as "solid", "liquid", "gas", or a "combination".

For this activity, I need to bring an object from the house or yard that will be interesting to classify based on the above categories, and...

- Is not dangerous
- Is not expensive
- Is non-allergenic
- Does not need to be refrigerated
- Is not harmful in any way
- It is not living (plant matter OK)
- Fits into this plastic bag

I will need this item for two classroom days, and then I can bring it home!

Look what I am doing in school!

I am learning about what the Earth is made of, and how these materials can be classified as solids, liquids, and gases.

Tomorrow in class we are going to sort or classify objects brought from home. We will first classify them as "natural" or "human-made" and then we will classify them as "solid", "liquid", "gas", or a "combination".

For this activity, I need to bring an object from the house or yard that will be interesting to classify based on the above categories, and...

- Is not dangerous
- Is not expensive
- Is non-allergenic
- Does not need to be refrigerated
- Is not harmful in any way
- It is not living (plant matter OK)
- Fits into this plastic bag

I will need this item for two classroom days, and then I can bring it home!

I found...

My name: _____

Directions: Find an example of a **Solid, Liquid, Gas, and Combination** and write or draw it in its box below.

Solid:

Liquid:

Gas:

Combination: