Volume water displacement worksheet

Empty layer. Empty layer. Empty layer. Empty layer. Empty layer. Empty layer. Empty layer. Empty layer. Empty layer. Empty layer.12 teachers like this lessonPrint LessonSWBAT: Measure the volume of multiple objects irregularly using water displacement. Students need to be exposed to various ways to measure volume and develop scientific skills. This lesson shows students how they can measure the volume of an irregular object. This lesson causes students to watch a TEDEd video that tells the story about Archimedes' volume discovery and then makes them develop a way to measure the volume of irregular objects. Emphasis is placed on making students think about the idea that objects take up space and therefore displace water, depending on the amount of space occupied by the object. Students present several methods for measuring the volume that is then used to introduce the importance of using a standardized instrument known as a graduated cylinder. Although this lesson does not necessarily address a specific content standard, it helps students establish a deeper conceptual understanding of what volume means and how it can be measured. In the process, students develop their ability to plan and conduct research (SP3). I want my students to think about the concept of volume and displacement of water before calculating the volume of irregular objects. I ask you how you would calculate the volume of an irregularly shaped crown. Field students' answers and then show them this video: Ask students why they can't calculate the crown volume using length x width x height. Have a discussion and then get into how scientists measure the volume of irregular objects using the Archimedes Principle. Ask students to come up with a way to measure the volume of irregular objects and to circulate around the room listening to their discussions. Then ask students to share their ideas. I want to add a student-centered item to this lesson, instead of showing them how to use water scrolling to find the volume of irregular objects. I begin by asking students how Archimedes might take the discovery of spilled water on the side of the bathtub when he came in to explain how they could find the volume of an object. 6-8 research planning and conduct is based on K-5 experiences and progress to include research that uses multiple variables and provides evidence to support explanations or solutions. Plan research individually and collaboratively, and in design: identify independent and dependent variables and controls, what tools are needed to perform the how measurements will be recorded and how much data is needed to support a claim. Conduct research and/or evaluate and/or review experimental design to produce evidence that serves as the basis for evidence that meets the objectives of the research. Assessing various methods of data collection. Collect data to produce evidence-based data to answer scientific questions or test design solutions under a number of conditions. Collect data on the performance of a proposed object, tool, process, or system under a number of conditions. I ask students: How can we find the volume of the crown? I give each group about 10 minutes to discuss what they would do. I will structure the discussion to build students' thinking, starting with an excavation into their own thinking, and then growing ideas through sharing. Structure of group work: 1) Everyone silently sketches an image and describes (in words) what they would do. (3 minutes) 2) One student at a time, per group, has 1 minute to share what they would do. (4-5 minutes) 3) Groups decide what they would do, depending on everyone's input, (5-8 minutes) 4) Each group then shares with the class what they would do. I ask what they would use to measure volume and take answers. Then I dislike introducing a graduated cylinder and how it works. First I show students how to calculate the volume of irregular objects in a worksheet. This increases their confidence before they are asked to calculate the volume of actual irregular objects using water displacement. I model one or two examples and then allow students to complete the Practice Worksheet with a pair. We review their responses to the worksheet and then move on to practicing volume measurement with water displacement. Since students already know how to read a graduated cylinder on the meniscus, I only give them a reminder. If you haven't covered this, make sure you do it now. I carefully observe the water level, exaggerating this action to draw attention to this critical first step. Then demonstrating the correct way to tilt the graduated cylinder and slide the object, taking care not to lose water. Next, I say they must subtract the old volume from the new volume to find the volume of the object. I have six stations created for groups of students to circulate. Each station has several elements to measure. Groups circulate at designated times and we review the volumes of multiple objects at the end of the class. Note: Make sure the objects fit into the graduated cylinder. Another useful activity is to have children compare the volume of the same object using two different containers, such as a graduated cylinder and a beaker. You can point to the error that occurs when we do not use the right instruments in laboratories and discuss how that can affect our results. Do you love this? Don't you love this? Please consider taking a moment to your comments with us. Thank you! A submerged object shifts a volume of liquid equal to the volume of the object. One milliliter (1 ml) of water has a volume of 1 cubic centimeter (1cm3). Different atoms have have sizes and masses. The atoms in the periodic table are arranged in order according to the number of protons in the nucleus. Although one atom may be smaller than another atom, it could have more mass. The mass of atoms, their size and how they are arranged determine the density of a substance. Density is equal to the mass of the object divided by its volume; D to m/v. Objects with the same mass but different volume have different densities. Students use the water displacement method to find the volume of different rods that have the same mass. They calculate the density of each rod and use the characteristic density of each material to identify the five rods. Students then consider the relationship between the mass, size, and arrangement of atoms to explain why different rods have different densities. Students will briefly submit to the periodic table. Objective Students will be able to explain that materials have characteristic densities due to the different mass, size and arrangement of their atoms. Students will be able to use the volume scrolling method to find the volume of an object. Assessment Download the student's activity sheet and distribute one per student when specified in the activity. The activity sheet will serve as the Evaluate component of each 5-E lesson plan. Safety Make sure you and your students wear appropriate glasses. Materials for each group Set of 5 different rods that have the same graduated cylinder mass, 100 ml of water in a cup Calculator Notes on the materials: For this lesson you will need a set of five solid rods, each with the same mass, the same diameter, but a different volume. Each rod is made of a different material. There are several versions of these rods available from different suppliers. This activity uses the Flinn Scientific Equal Mass Kit (Product #AP4636) but can be adapted to any set of equal mass rods. Because there are only five samples in the Equal Mass kit, you may need two kits so that each group can work with one sample. This chart will help you identify each rod. Do not disclose this information to students. You will discover the identity of each rod and the inverse relationship between the density and length of each rod later in this lesson. Table 1. Physical properties of solid sinkowo cylinders. Sample material Approximate density (g/cm3) Relative length Smaller Smaller Metal Brass 7.5 shorter gloss grey metal Aluminum 3.0 Dark grey Pvc 1.4 White Aluminum Nylon 1.1 Higher white aluminum 0.94 Longer Show students the five rods and explain that they all have the same mass. Then hold the more rods shorter and medium-sized and remind students that they have the same mass. Ask students to make a prediction: Which rod is the densest? Less dense? In the middle? Students may reason that since the mass of each rod is the same, the volume of each rod must have to do with their density. Some may say that the rod with the smallest volume must have the highest density, because the same dough is packed in the smallest volume. Or that the rod with the largest volume should have the lowest density, because the same mass extends over the larger volume. Tell students that like the cubes in the previous activity, they will need to know the volume and mass of each sample. They will also calculate the density of each sample and use this value to find out what material each rod is made of. Project the Water Offset animation. Play the animation as you demonstrate the method of moving water using a water cup, graduated cylinder, and rod, as students will in the activity. Use the dark gray plastic swatch to help students see it better. Volume Demonstrate what students will do by pouring water from a cup into a 100 ml graduated cylinder until it reaches a height that covers the sample. This is the initial water level. Tell students that the surface of the water in a tube may not be completely flat. Instead, the surface can curve into a shallow U-shape called a meniscus. When measuring, read the line right at the bottom of the meniscus. Tilt the graduated cylinder and slowly slide the sample into the water. Hold the graduated cylinder upright. Record the water level. Point out that this is the final water level. Tell students you want to find out how much the water level changed. Subtract the initial water level from the final water level to find the volume of the rod. Sample volume: final water level, initial water level. Students may be confused that the unit of volume in the graduated cylinder is milliliters (ml), when in the previous lesson students calculated the volume in cubic centimeters (cm3). Explain to students that 1 ml is the same as 1 cm3. Click the oval-shaped button on the first screen of the animation marked 1 mL at 1 cm3. Ask students: When you place a sample in the water, why does the water level rise? The volume that the rod takes pushes or displaces the water. The only place for the water to go is to go up. The amount or volume of displaced water is equal to the volume of the sample. Is the sample volume equal to the final water level? No. Students should realize that the volume of the rod is not equal to the water level in the graduated cylinder. Instead, the volume of the rod is equal to the amount that the water rose in the graduated cylinder (the amount displaced). To find the amount of displaced water, students must subtract the initial water level (60 ml) from the final water level. What units use when recording the volume of the sample? Because they will use the volume to calculate density, students must record the sample volume in cm3. Mass student you won't have to measure the mass of the rods. The mass of each rod is the same, 15 grams, and is given on its chart on the activity sheet. They will have to measure the volume of each of the five different rods and calculate their densities. Students will use their density values to identify each rod. Density Demonstrate how to calculate density (D to m/v) by dividing mass by volume. Point out that the response will be in grams per cubic centimeter (g/cm3). Give each student a activity sheet. Students will record their observations and answer questions about the activity on the activity sheet. The Explain it with atoms and molecules and Take it more sections of the activity sheet will be completed as a class, in groups or individually, depending on your instructions. Look at the teacher's version of the activity sheet to find the questions and answers. Give students time to answer questions 1–5 on the activity sheet before starting the activity. Note: The densities of the three plastics are similar, so students should be very careful when measuring their volume using the water displacement method. In addition, it is difficult to measure the volume of the smaller rod. Give students a clue that it is between 1.5 and 2.0 ml. Question to investigate Can you use density to identify the five rods? Materials for each group Set of five different rods that have the same graduated cylinder mass, 100 ml of water in a teacher preparation calculator cup Use a permanent marker to mark the five rods with letters A, B, C, D, and E. Keep a record of which letter corresponds to which sample is without informing students. If you are using two or more sets of rods, be sure to mark each sample of the same material with the same letter. After a group finds the volume of a sample, they must pass that sample to another group until all groups have found the volume of the five rods. For the longer, floating sample, students can use a pencil to gently push the sample just below the water surface to measure its full volume. Procedure Pour enough water from the cup into the graduated cylinder to reach a height that covers the sample. Read and record the volume. Tilt the graduated cylinder slightly and carefully place the sample in the water. Place the graduated cylinder upright on the table and look at the water level. If the sample floats, use a pencil to gently push the top of the sample just below the water surface. Record the number of milliliters for this final water level. Find the amount of water displaced by subtracting the initial water level from the final level. This volume is equal to the cylinder in cm3. Record this volume in the activity sheet chart. Remove the sample by pouring the water back into the cup and removing the sample from its graduated cylinder. Calculate Calculate density using formula D to m/v. Record density at (g/cm3). Trade samples with other groups until you have measured the volume and calculated the density of the five samples. Table 2. Volume, Mass, and Density for UnknownS A–H Displays Initial Water Level (mL) Final Water Level (mL) Rod Volume (cm3) Mass (g) Density (g/cm3) A 15.0 B 15.0 C 15.0 D 15.0 E 15.0 Compare the calculated density values with the chart values. Then type the letter name for each swatch in the chart. Note: The densities students calculate may not be exactly the same as the densities given on the chart. While students are working, check their volume values to make sure they are using the difference between the final and initial water levels, not just the final level. Table 3. Volume, mass and density for unknown Material A–H Approximate density (g/cm3) Sample (Letters A–E) Brass 8.8 Aluminum 2.7 PVC 1.4 Nylon 1.2 Polyethylene 0.94 Discuss student values for density for each sample. Point out that different groups may have different values for density, but that most values are close to the chart values. Ask students: Each group measured the volume of the same samples. What are some reasons why groups may have different values for density? Students should realize that small inaccuracies in volume measurement can explain differences in density values. Another reason is that the graduated cylinder, in itself, is not perfect. So there's always some uncertainty in the measurement. Remind students that at the beginning of the lesson they made a prediction about the density of the small, medium, and long sample. Students should have predicted that the longer cylinder has the lowest density, the shorter cylinder has the highest density, and the medium is somewhere in the middle. Ask students: Was your prediction about the density of these three samples correct? Ask students to look at their chart with the mass, volume, and density values for each cylinder. Ask them to look for a relationship between volume and density. Students should realize that the shorter cylinder has the highest density and the longest cylinder has the lowest density. Is it fair to say that if two samples have the same mass as the one with the largest volume, it will have a lower density? Yes. Why? Because the samples have the same mass, their volumes will give you an idea of their densities according to equation D to m/v. If there is a larger number for the volume in the denominator, the density will be lower. Is it fair to say that the one with the smallest volume will have a higher? Yes. Why? If a smaller number for the volume is in the denominator, the density will be higher. Project the Atomic Size and Mass image. Tell students that this chart is based on the periodic table of items, but that it only includes the first 20 items of 100. A representation of one atom is displayed for each element. For each element, the atomic number is above the atom and the atomic mass is below. This graph is special because it shows both the size and mass of atoms compared to other atoms. Note: Students may want to know more about why atoms have different atomic numbers and different sizes. These questions will be discussed in later chapters, but you can tell that the atomic number is the number of protons in the center or nucleus of the atom. Each element has a certain number of protons in its atoms, so each element has a different atomic number. The size difference is a little harder to explain. Atoms have positively charged protons in the nucleus and negatively charged electrons moving around the nucleus. It is really the space that electrons occupy that makes up the majority of the size of the atom. As the number of protons in the atom increases, both its mass and the strength of its positive charge increases. This additional positive charge brings the electrons closer to the nucleus, making the atom smaller. Atoms become larger in the next row because more electrons are added in a space (energy level) further away from the nucleus. Let students know that they will learn more about the periodic table and atoms in Chapter 4. For now, all students need to focus on the size and mass of atoms. Tell students that the difference in density between small, medium, and large samples they measured can be explained based on the atoms and molecules they are made of. Project the Polyethylene image (longer bar). Polyethylene is made of long molecules of only carbon and hydrogen atoms. In the Atomic Size and Mass chart, the carbon mass is quite low, and the hydrogen mass is the lowest of all atoms. These low masses help explain why polyethylene has a low density. Another reason is that these long, thin molecules are freely packaged together. Project the Polyvinyl Chloride (Medium Length Bar) image. Polyvinyl chloride is composed of carbon, hydrogen and chlorine atoms. If you compare polyvinyl chloride with polyethylene, you'll notice that there are chlorine atoms in some places where there are hydrogen atoms in the polyethylene. In the table, chlorine has a large mass because of its size. This helps make polyvinyl chloride denser than polyethylene. The density of different plastics is usually caused by the different atoms that can be connected to carbon: hydrogen chains. If they are heavy atoms for their size, plastic tends to be denser; if they are light for their size, plastic tends to be less dense. Brass image (shorter bar). Brass is a combination of copper and zinc atoms. Copper and zinc appear later in the periodic table, so they are not shown on the chart, but both are heavy for their size. Atoms are also very close. For these these brass is denser than polyethylene or polyvinyl chloride. Ask students to refer to the illustration of calcium and sulfur on their activity sheets. Explain that a calcium atom is larger and heavier than a sulfur atom. But a piece of solid sulfur is denser than a solid piece of calcium. The sulphur density is approximately 2 g/cm3 and the calcium density is approximately 1.5 g/cm3. Ask students: Based on what you know about the size, mass, and arrangement of atoms, explain why a sulphur sample is denser than a calcium sample. Although a sulfur atom has less mass than a calcium atom, many more sulfur atoms can pack together in a certain amount of space. This gives sulfur more mass by volume than calcium, making it denser. Dense.