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ABSTRACT

This autoinstructional program, developed as part of a general science course, is offered for students in the middle schools. Mathematics of fractions and decimals is considered to be prerequisite knowledge. The behavioral objectives are directed toward mastery of determining volumes of solid objects using the water displacement method as well as by using measurements made with a metric ruler. The equipment needed is listed. Time allotment is 12 minutes. A bibliography is included with the student script. (EB)

LITER - METRIC VOLUME

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June 30, 1973

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TEACHER'S GUIDE

PACKET NUMBER	389.152 Sv
SUBJECT	General Science
TITLE	Liter - Metric Volume
LEVEL	Middle School
PREREQUISITES	Mathematics of fractions and decimals
BEHAVIORAL OBJECTIVES	Given a 100 ml graduate, 250 ml beaker, 250 ml Erlenmeyer flask, Florence boiling flask, 4 unknown volumes of water and 4 unknown volumes of mercury, the student should read the meniscus of at least 7 volumes to the nearest ml. Given a 100 ml graduate, 50 ml of H_2O, wooden block, and a stone, the student using the water displacement method should determine the volume to the nearest ml of a wooden block and a stone. Given a 100 ml graduate, 50 ml of H_2O, three different sized wooden blocks, and a metric ruler with mm divisions, the student by measuring the wooden blocks to the nearest tenth of a centimeter and by reading the displaced water (water displacement method) to the nearest ml should compare the cm units of length with the ml units of volume of the three wooden blocks.
EQUIPMENT * included in packet ** must be prepared in advance	** 100 ml graduate * slides 1-9 * vocabulary list ** slide viewer ** scratch paper ** mercury ** test tube ** envelope "A" * script * student guide * cassette tape * note to teacher performing lab set-up * chart E

TEACHER'S GUIDE

TIME	12 minutes
SPACE REQUIRED	x Carrel x Other (lab) Note: Carrel must be provided with 110-120 v, 60 cycles of elec.
BIBLIOGRAPHY	Modern Science, Smith, Blacha, Pless, Laidlaw Brothers; 1972, Atlanta, Ga. Inquiry into Earth and Space Science, Jacobson and others; American Book; Van Nostrand Co.; 1969, New York Modern Science: Earth, Matter, and Space; Blancent Fischler; Holt, Rinehart, and Winston; 1967, New York Interaction of Matter and Energy; Abraham and others; Rand McNally; 1968; New York Modern Physical Science; Tracy, Tropp, Friedl; Holt, Rinehart, and Winston; 1970, New York

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Since liquids flow and can be poured, their size cannot be measured easily. The length, width, or height of a liquid cannot be measured, for the liquid will not retain a definite shape for a long enough period of time. Instead, a liquid is poured into a container to see how much of the space in the container is taken up or occupied by the liquid. You are familiar with the container that is occupied by a liquid. Such liquid volume as a "cup" of coffee, 12 "ounces" of soda, 1 "quart" of milk, 5 "gallons" of water, a "barrel" of oil, are well known. Scientists also measure liquid volumes by pouring the liquid into a container and observing how much space in the container is occupied by the liquid. The scientists use different units to express how much space the liquid occupies. Instead of using "ounces", "quarts", and "gallons", scientists use liter, ml, and other variations as seen on Chart E. (Pause)

As you do this exercise, you will become familiar with the techniques of measuring liquid volumes. You will also learn the reading of markings on scientific containers, and the units the scientists use to express liquid volume. Remember, misunderstood instructions should be re-heard. Music indicates stopping the tape, performing the operation, and proceeding with the tape.

Observe the level of water in the graduate. (Pause) Turn to

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SLIDE 1. (Pause) This graduate is like the one in front of you. Make certain you observe the liquid at eye level as is shown in SLIDE 2. (Pause) Does the surface level of the water form a straight line across? (Pause) No. Where is the liquid higher? (Pause) At the sides of the graduate. Use scratch paper and draw a diagram that shows how the top surface of the water looks and then draw another diagram of the top surface of the mercury, the silvery liquid in the test tube. (Pause) Music. Look at both diagrams. (Pause) How do they differ? (Pause) Top surface of water is shaped like a "U", while top surface of mercury is shaped like an inverted "U".

When you measure the volume of any liquid, look at the bottom of the curved surface. This curved surface is called the meniscus. Again, turn to SLIDE 2. (Pause) Make certain you know where this meniscus is. (Pause)

Examine the graduate. Note the marks. The large lines with the numbers show the milliliters. The unit of liquid volume is called milliliter and is abbreviated ml. Turn to SLIDE 3. (Pause) Notice the markings and ml abbreviation. Sometimes a graduate will be marked "cm^3", as is seen in SLIDE 4. (Pause) This is not a mistake, only another way of writing ml. "Cm" equals ml.

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Look at SLIDE 5. (Pause) What is the volume in the graduate? (Pause) 21 cm^3. Other times you may see the marking of cc. This means cubic centimeter and is equal to ml. Look at SLIDE 6. (Pause) This is a measure of metric length. Only in the metric system can you inter-relate length and volume units.

Turn to SLIDE 7. (Pause) Study the volume occupied by ml, cl, and liter. Music.

Have you heard of the words, water displacement? (Pause) This happens when an object is put in a container of liquid, such as a person in a tub of water. The water level rises when the person sinks lower in the tub. Go back to SLIDE 3. (Pause) Here is a graduate with 75 ml of water. When a stone is slowly lowered into the graduate, the water level rises. You see this in SLIDE 8. (Pause) What is the graduate reading now? (Pause) 91 ml. What volume of water did the stone move when it was lowered in to the graduate? (Pause) 16 ml or 91 ml minus 75 ml. Turn to SLIDE 9. (Pause) Here is another example of water displacement. The entire stopper is lowered into a graduate, water rises. The volume of water that is displaced is equaled to the volume of the stopper. In this case, 15.3 cc.

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Let's see how well you read volumes and water displacement. Remove the paper from envelope "A". Follow its directions and perform the exercise in the lab. Make certain you clean your work area in the carrel and in the lab. Music.