

CB 18 A Trash Audit

Just how much trash do you generate? What makes up your trash? Who else is involved in making the trash thrown in with yours? How much trash does your biology class create? You can find the answers to some of these questions by doing a trash audit.

A trash audit is a study of the amount and types of trash produced from a particular source. In this inquiry, you will examine one specific source of trash, choosing a source with which you are directly involved. There are several possible sources that you might study, such as trash in your classroom, your school, or your home. Your teacher will explain your options and also the length of time that you will be involved in the audit.

Materials

- disposable plastic gloves
- large plastic garbage bag
- trash (see your teacher to identify the source of the trash)
- balance
- Casio fx2 Graphing Calculator
- Casio QV2800 Digital Camera

Safety Considerations

- Wear rubber or latex gloves when handling trash.
- Do not handle trash directly.
- Do not handle any trash which contains broken glass or any other sharp edges

Procedure

1. Collect trash for this audit. If you collect for more than two days, be sure to remove or rinse out any trash, such as food, that may rot or smell.
NOTE: A few days worth of trash should give you a manageable amount.
2. Place the trash in a large plastic bag as you collect it. Tie off the top of your bag and take a digital image next to a meter stick for comparison.
3. Estimate the volume of the trash in your bag. Record this value in your *Log*.
HINT: Shake the contents around in the bag until it has a rough spherical shape.
Calculate trash volume using the formula for the volume of a sphere.

$$V = 4/3 \pi r^3$$

Where V = Volume and r = radius.

4. Determine the mass of the trash. Record this value in your *Log*.
5. Discuss as a class how you might sort the trash. Begin by listing some possible categories of trash. Record your individual and class lists in your *Log*.
6. Decide which trash can be recycled, reused, or composted. Designate a special place or container for this trash.
7. Wearing safety gloves, sort out the trash that can be recycled, reused, or composted.
8. Determine the weight and volume of the remaining trash. Record this information in your *Log*. How would you dispose of this trash?
9. Draw a flow-chart showing how these materials flow from their source to you and on to the trash pile.

Interpretations Answer these questions in your *Log*.

1. What materials are in the trash you collected?
2. How much of this trash is packaging material?
3. If you collected trash from your school or home, estimate how much garbage might be produced from that source each day. How much might be produced each year?
4. What percentage of the trash you collected can be recycled, reused, or composted?
5. When you sort out all of the trash that can be recycled, reused, or composted, what percentage of the original trash is left?
6. Where does your garbage go when you throw it away?
7. Where is "away?"
8. Who is responsible for the trash you've collected when you throw it away?
9. What types of raw materials were required to make the items you found in the trash?

Applications Answer these questions in your *Log*.

1. Does your school have a recycling program in place? What is recycled and how?
2. What kind of recycling program is in place in your community?
3. What does your family do with old newspapers?
4. What happens to old automobile tires in your area?
5. Some communities have what they call a "disposal" or "reuse" fee which is added to the price of some items: tires, motor oil, drinks in aluminum cans, or drinks in plastic bottles. Does your community have a disposal fee? What is the fee in your community for each of these items?
6. Does your community charge other disposal fees?
7. Describe any programs in your community which attempt to reduce, reuse, or recycle commonly used materials in new or innovative ways.
8. How could you reduce the amount of packaging materials in trash?

Casio FX 2.0 Calculator Procedures for CB 18

Volume of Trash

In order to estimate the volume of the trash found in your bag, you will need to squeeze out some of the air, without compressing the trash. To do this, grasp the top of the bag in your hand and gather it in so that your hand is wrapped completely around the top. Set your bag on the floor and lightly press the top of the bag which is grasped in your hand downward, so that air escapes the bag through a small opening you allow in the top of the bag you are holding. Do not press down so hard that the trash is pressing or crushing. Once you have squeezed out as much of the air as you can without crushing the trash, place a tie wrap around the top of the bag, as close to the trash as you can get it. Now shape the bag into a ball or spherical shape as best you can. To find the volume of the bag, you will use this formula:

$$V = \frac{4}{3} \pi r^3$$

where V=Volume and r=radius.

- ☞ First you will need to determine the radius of your "trash ball." There are a couple of ways you might accomplish this. One way is to measure for the diameter directly, then take half of that. (Recall that radius is equal to half the diameter.) The diameter is the distance across the thickest part of the "trash ball." This may be somewhat difficult, since the bag is closed and you do not want to tear it in order to measure through it. Discuss possible ways to measure the widest distance across the "trash ball" with your partner(s) and try different approaches and compare the results. Choose the diameter that you think is the most accurate. If you are not sure, ask your teacher for help.
- ☞ Another possible way to find the radius is with an "indirect" method. The circumference of the sphere would be much easier to determine from your "trash ball." Using a metric tape measure, measure around the largest part of the "trash ball." This should be located approximately around the center of the "trash ball." Using the formula for circumference, $C=2\pi r$, substitute the value you find for the distance around the "trash ball" in for C. Now use some algebra to solve the equation for r ,

$$r = \frac{C}{2\pi}.$$

- ☞ Let's suppose that the value you found for C was 278 centimeters or 2.78 meters. To use the Casio FX2.0 for finding the radius, after you have turned the calculator on, press the gray [MENU] button near the top of the key pad. Then press [1] for RUN-MAT which will take you to the screen for calculations. To find r , enter 2.78 (or the number that you found for C.) Then enter [\div], followed by the left parentheses [(), then [2], the times button [x], then [SHIFT] the gold button, then [EXP], (this activates π), and the right parentheses [)]. Finally press [EXE]. So for this example the radius is approximately 0.442 m. or 44.2 cm. See below.

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2.78/(2×π)
0.4424507418
278/(2×π)
44.24507418
MAT

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☞ Now we are ready to find the volume, $V = \frac{4}{3}\pi r^3$. From the RUN-MAT menu, enter the left parentheses, [(], then [4], then [÷], then [3], then the right parentheses, [)]. Next enter π by pressing [SHIFT], then [EXP]. Press the times button [x] then the value you found for r, followed by the *hat* button, which looks like a house top, [^], and then [3]. Finally press [EXE]. For this example, we will 0.442 for r. See below.

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(4/3)π×.442^3
0.3617057538
MAT

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Notice that since you raised the radius value (which was in meters) to the third power, the unit meters is now expressed to the third power, which is the correct unit for volume measurement. Thus the volume I would write in my *Log*, based on my radius measure, would be Volume=0.361 m³. (If you used the centimeter radius, then the volume would be approximately 361,700 cm³.)

Percentages of Recyclable, Reusable, Compostable Trash

Separate your trash into four piles: recyclable, reusable, compostable, and none of these. In a similar fashion that you determined the volume of the trash, find the volume of each of the four piles. To find the percentages of each, divide the volume of the small pile by the total volume of all the trash, and then multiply by 100. Note: Since you estimated the volume of the trash and of each of the piles there may be some discrepancy in the numbers. Make an effort to see that the total volume of all the trash is as close as possible to the total volume of each of the four piles added together.

Another interesting percentage is the percentage of trash that is found in packaging materials. Separate the packaging trash from the rest of the trash and determine its volume. Divide that number by the total volume of trash and multiply by 100. Can you think of ways to minimize this percentage?