**Student or Group Name:**  **Date:**

|  |  |  |
| --- | --- | --- |
|  | **Activity 1-****Build Your Own Spirometer!** |  |

Spirometers are used to measure the amount of air that fits in your lungs and how much air you normally inhale and exhale.  This is very useful in learning about our bodies and can help doctors determine if we are sick.

**Materials:**

3-liter clear soda bottle (empty) with cap, or for larger students, a milk jug or bottle that holds over 3 liters

2-foot long piece of plastic tubing for each student (can be cleaned at the end of the experiment)

250 ml graduated cylinder

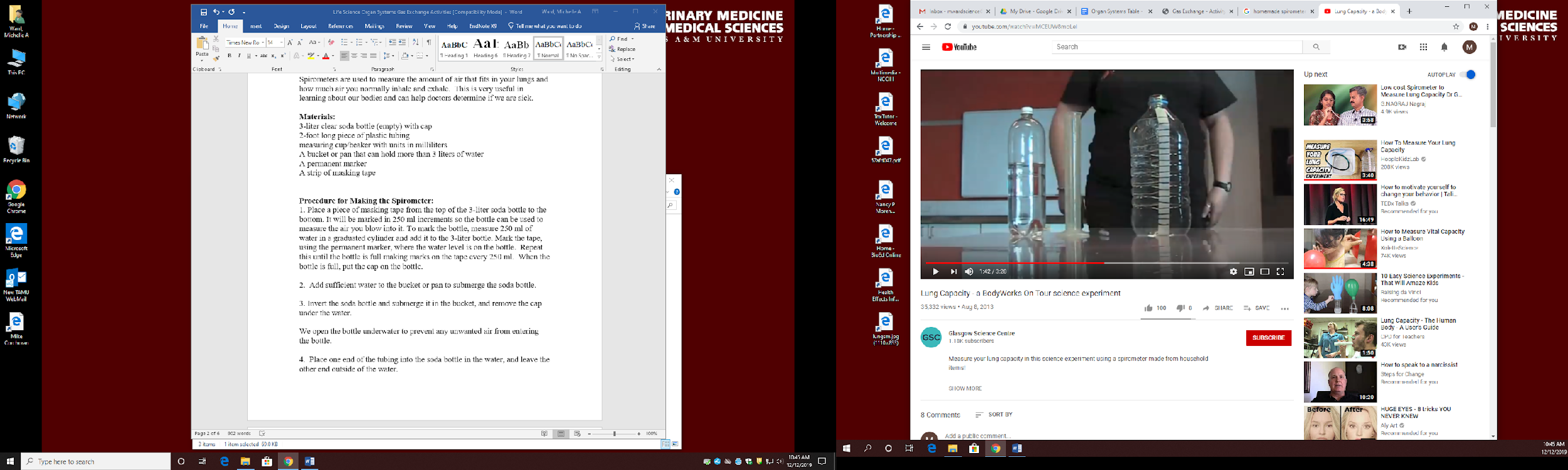
A bucket or pan that can hold more than 3 liters of water

A permanent marker

A length of masking tape

**Procedure for Making the Spirometer:**

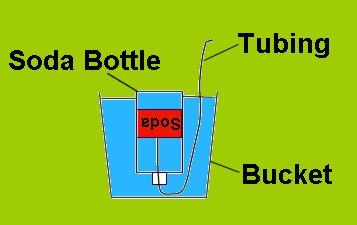
1. Place a piece of masking tape from the top of the 3-liter soda bottle (or larger bottle) to the bottom. It will be marked in 250 ml increments so the bottle can be used to measure the air you blow into it. To mark the bottle, measure 250 ml of water in a graduated cylinder and add it to the 3-liter bottle. Mark the tape, using the permanent marker, where the water level is on the bottle. Repeat this until the bottle is full making marks on the tape every 250 ml. If the last mark is less than 250 ml from the top, just fill the bottle to the top and do not put a last measuring mark. When the bottle is full, put the cap on the bottle. The bottle should look like the picture below.



2. Add sufficient water to the bucket or pan to submerge the soda bottle.

3. Invert the soda bottle and submerge it in the bucket, and remove the cap under the water. You could also carefully place your hand over the open end of the full bottle and submerge that end in the water and then remove your hand.

4. Place one end of the tubing into the soda bottle in the water, and leave the other end outside of the water.



A simple spirometer

**Tips:**

-Remember to place the bottle in the water upside down before removing the cap or your hand.

-Don't forget to insert one end of the hose in the bottle after you open the cap underwater

-Before you exhale into the tubing, your spirometer should resemble the above picture.

For a video demonstration of how to make a spirometer, [click here](https://www.youtube.com/watch?v=cy4kzOeLD5E).

**Procedure for Using the Spirometer:**

1. While a partner holds the bottle to keep it from flipping over, inhale as much air as possible, then exhale all of the air into the tubing connected to the spirometer. Be sure to blow out all the "extra" air in your lungs. The bottle will now have a large amount of air in it. Count the number of marks above the water level.

Number of marks: \_\_\_\_\_\_\_\_\_\_\_\_\_\_

How much air can my lungs hold?

To get a good estimate of your vital capacity, or the greatest volume of air that can be expelled from the lungs after taking the deepest possible breath, multiply the number of marks times 250 milliliters. That will give you total milliliters of air expelled.

Number of marks x 250 ml = vital capacity ml

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ x \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ml

To convert that number to liters, divide your total by 1000 ml.

Vital capacity ml ÷ 1000 ml = vital capacity in l

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ ÷ 1000 ml = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_l

This is a good estimate of your vital capacity.

**Questions:**

Estimated Vital Capacities

Males by Height

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Height | 150–155 cm (5'–5'2") | 155–160 cm (5'2"–5'4") | 160–165 cm (5'4"–5'6") | 165–170 cm (5'6"–5'8") | 170–175 cm (5'8"–5'10") | 175–180 cm (5'10"–6') |
| Vital Capacity (cm3) | 2900 | 3150 | 3400 | 3720 | 3950 | 4300 |

Males by age

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Age | 15–25 | 25–35 | 35–45 | 45–55 | 55–65 |
| Vital Capacity (cm3) | 3425 | 3500 | 3225 | 3050 | 2850 |

1. Look at the tables above. In the first table, what trend do you see in the data comparing the height of a male to his vital capacity? Why do you think this occurs?
2. In the second table, what trend do you see in the data comparing the vital capacity of males with their age? Why do you think this happens?
3. The vital capacity of women is slightly lower than that for men of the same height and age. Can you give a reason why that might occur? (hint: it has nothing to do with fitness levels)
4. Compare your estimated vital capacity with the tables. Do you think your vital capacity is in the normal range? Remember, you may be younger than the youngest age on this table, and if you are a female, your numbers should be less than reported on these tables.
5. What are two things that could change your vital capacity for the worse (the number would go down), and why would they cause a change?