Nasco Education™

LESSON PLAN

STEM/ STEAM

Developed with Laura Beres

Take a breath – Modeling the respiratory system

Volume 8 | Gr. 9-12

Time: 50+ mins.

HS–LS1–2

Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms.

Materials list

- Scissors
- 4 large balloons
  (3 for the model, 1 for lung capacity test)
- 2 rubber bands
- Electrical tape
- Plastic 2-liter bottle
- Flexible plastic tubing – 8"
- Y-shaped hose connector

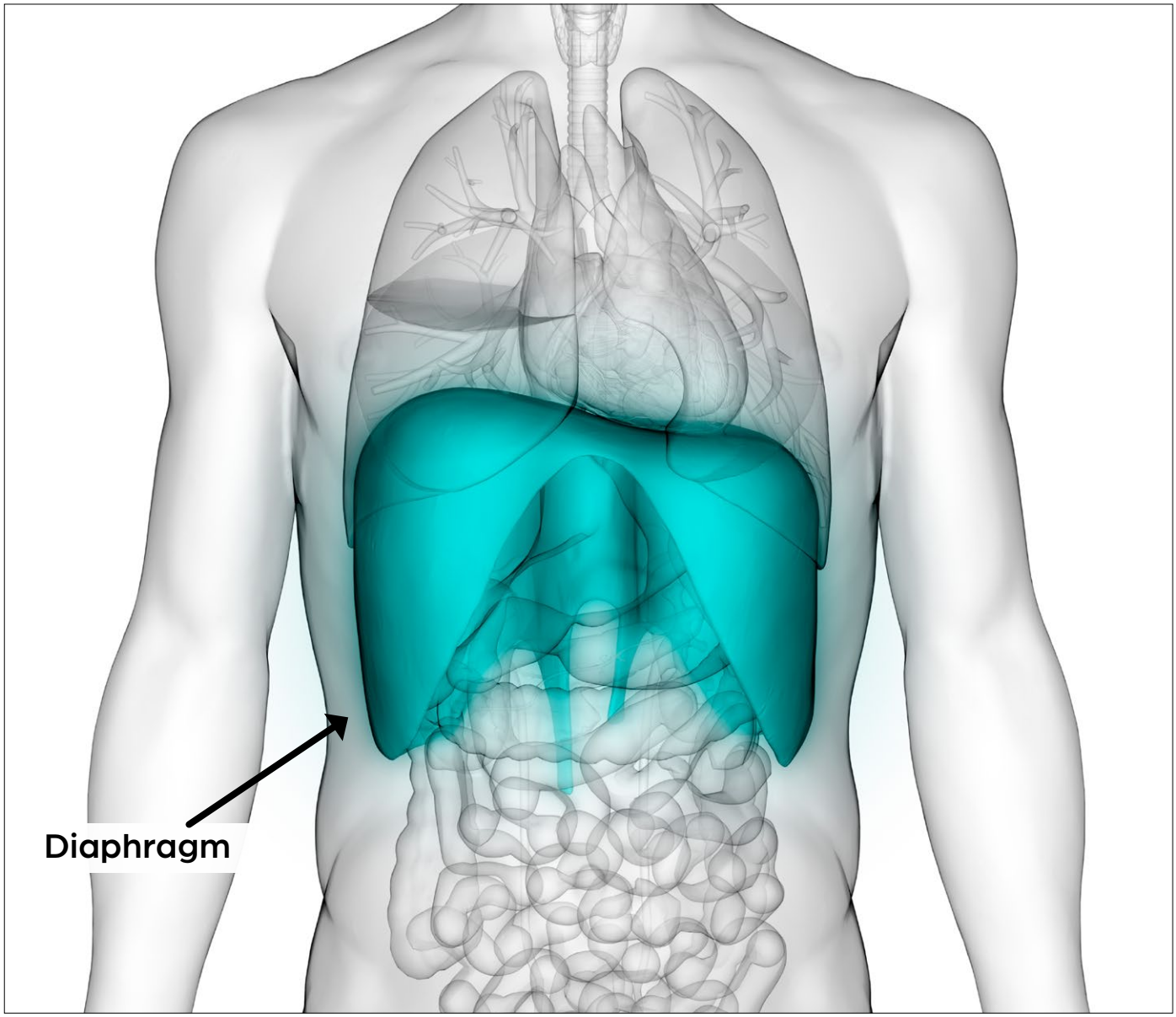
Objective

Students will...

- Be able to create a model of the respiratory system and measure lung capacity

Extensions and content connections

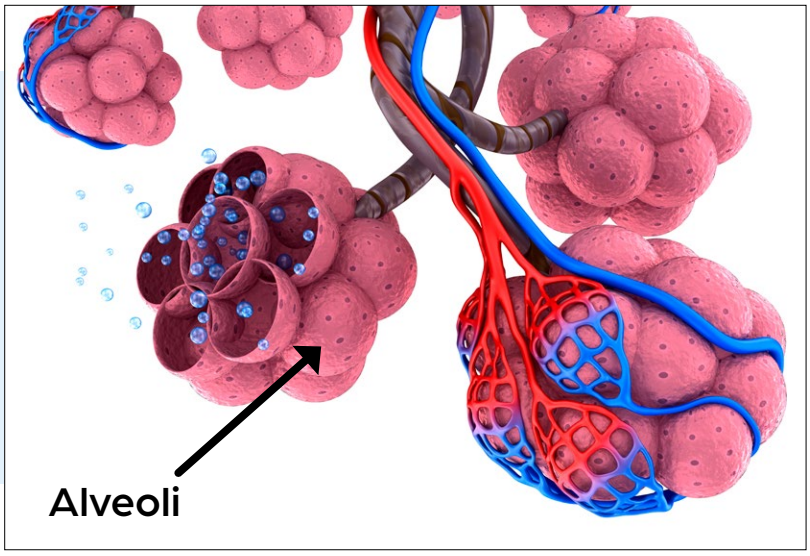
- Some students might choose to make a more or larger detailed model using other materials.
- **Optional Extension:** Discuss drowning and its impact on breathing. Students could mimic drowning by filling balloons with water and see what "breaths" they can take using the model. Students might see that a small amount of water may still allow breaths, but large amounts of water will not allow gas exchange.



Misconceptions

- The lungs expand and contract for breaths. Students have a hard time realizing there is the diaphragm and what it does.

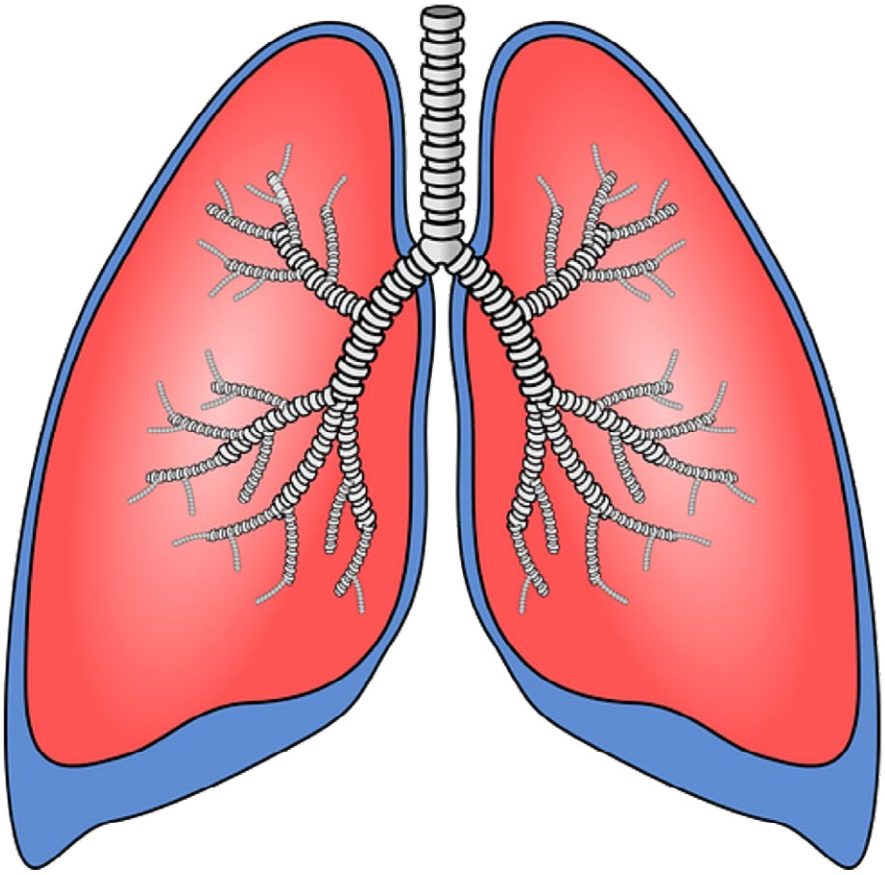
- The lungs are hollow like a balloon. Lungs are dense with millions of alveoli, where gas exchange takes place.



Name: _____ Date: _____

Take a breath – Respiratory system model

Directions: Label the following diagram of the respiratory system:



What is the role of the diaphragm?

_____

_____

_____

_____

_____

_____

Materials

- Scissors
- 3 large balloons
- 2 rubber bands
- Electrical tape
- Plastic 2-liter bottle
- Flexible plastic tubing – 8"
- Y-shaped hose connector
- 2 meter sticks

Directions

1. Gather materials.
2. Insert the plastic tubing into one of the openings of the hose connector and use electrical tape to make an airtight seal around where the two pieces meet.
3. Connect a balloon around each of the remaining two openings and secure with rubber bands.
4. Measure 2" from the bottom of the 2-liter bottle and cut to remove the bottom.
5. Place the structure from steps 2 and 3 into the bottle. The plastic tubing should come through the neck of the bottle.
6. Use electrical tape to seal the opening of the bottle where the plastic tubing comes through. This should be an airtight seal.
7. Tie a knot at the end of the remaining balloon and cut the main part of the balloon in half horizontally. Using the knotted half of the balloon, stretch the open end over the bottom of the bottle.
8. Gently use the knot to pull down on the balloon, then release the balloon with the knot and watch what happens.

Name: _____ Date: _____

Take a breath – Respiratory system model

Directions: Fill in answers.

Process Explained:

In this model, the structures of the respiratory system are represented as follows:

Plastic bottle = _____

Plastic tubing = _____

Y-shaped connector = _____

Balloons inside bottle = _____

Balloon covering the bottom of bottle = _____

Think It Through:

1. What brings oxygen to all parts of the body? _____

_____

2. What waste products are created by breathing? _____

_____

3. What does pulling the balloon down represent? _____

_____

4. When you inhale:
   a. The ribs move _____.
   b. The diaphragm moves _____.
   c. There is now _____ space in the chest area.
   d. Air rushes _____ to fill this space.
5. When you exhale:
   a. The ribs move _____.
   b. The diaphragm moves _____.
   c. There is now _____ space in the chest area.
   d. Because of this pressure, air moves _____ the lungs.

Testing lung capacity — handout 2

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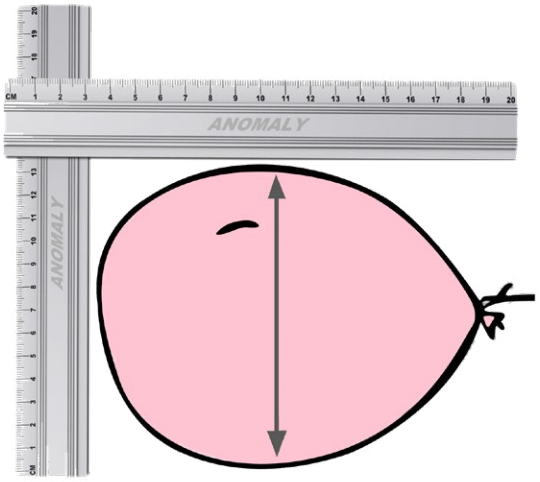
Name: _____ Date: _____

Vocabulary:

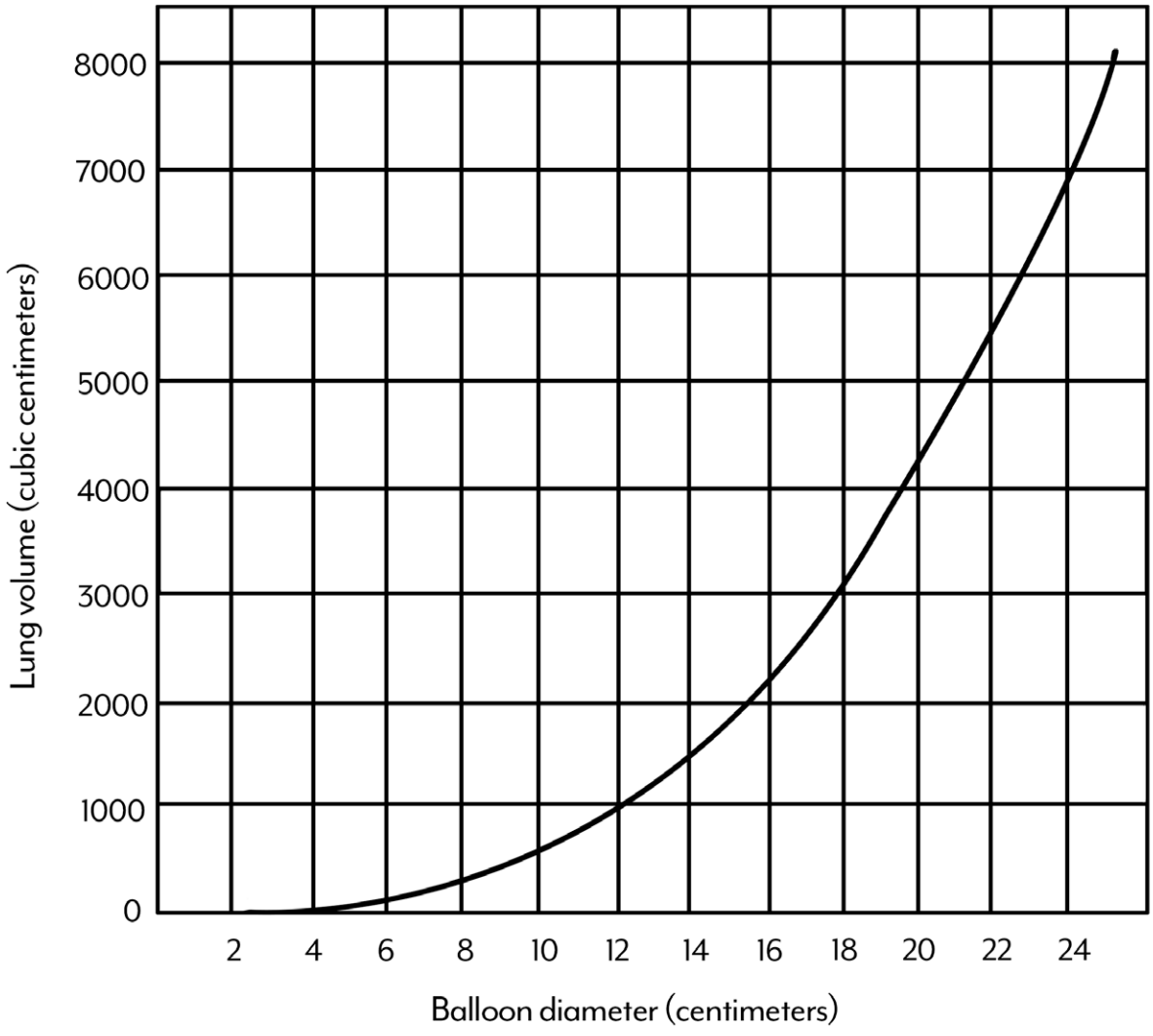
Tidal Volume – The amount of air that you move in and out of your lungs while breathing normally.

Vital Capacity – The maximum amount of air moved in and out of the lungs.



Measure Vital Capacity:

Stretch a round balloon several times to stretch it out. Take a deep breath and then exhale into the balloon. Pinch the end of the balloon and measure its diameter in centimeters. Record on data table. Use the graph below to convert diameter to volume.



Testing lung capacity — worksheet 2

Name: _____ Date: _____

	Subject Data				Vital Capacity		
	Sex	Height	Age	Activity Level (low, medium, high)	Balloon Diameter	Volume (from graph)	Volume (from calculator)
Subject 1							
Subject 2							
Subject 3							
Subject 4							

How might an athlete's vital capacity compare to a non-athlete? What about a child compared to a teenager or an adult? Explain your reasoning.

_____

_____

_____

_____

Which factor (sex, height, age, activity level) has the greatest impact on vital capacity?

_____

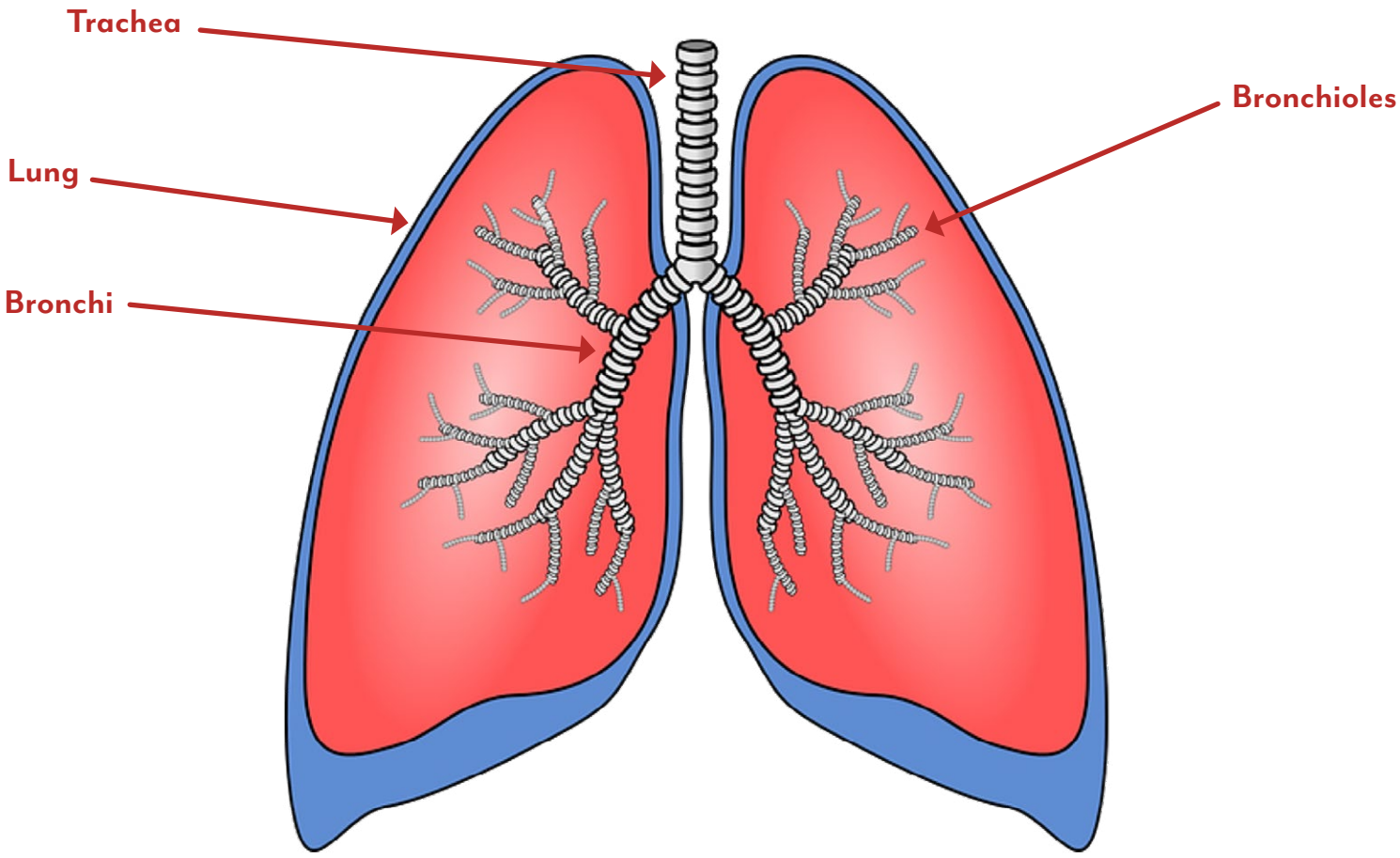
_____

_____

_____

Take a breath – Respiratory system model

Directions: Label the following diagram of the respiratory system:



What is the role of the diaphragm?

The diaphragm is an involuntary muscle that expands and contracts to allow air to go into and out of the lungs.

Name: _____ Date: _____

Take a breath – Respiratory system model

Directions: Fill in answers.

Process Explained:

In this model, the structures of the respiratory system are represented as follows:

Plastic bottle = **chest cavity/rib cage**

Plastic tubing = **trachea**

Y-shaped connector = **bronchi**

Balloons inside bottle = **lungs**

Balloon covering the bottom of bottle = **diaphragm**

Think It Through:

1. What brings oxygen to all parts of the body? **Red blood cells in the circulatory system**
2. What waste products are created by breathing? **Carbon dioxide and water vapor**
3. What does pulling the balloon down represent? **Diaphragm contracting**
4. When you inhale:
   a. The ribs move **outward**.
   b. The diaphragm moves **downward**.
   c. There is now **extra** space in the chest area.
   d. Air rushes **in** to fill this space.
5. When you exhale:
   a. The ribs move **inward**.
   b. The diaphragm moves **upward**.
   c. There is now **less** space in the chest area.
   d. Because of this pressure, air moves **out of** the lungs.

Testing lung capacity — worksheet 2 answer key

	Subject Data				Vital Capacity		
	Sex	Height	Age	Activity Level (low, medium, high)	Balloon Diameter	Volume (from graph)	Volume (from calculator)
Subject 1							
Subject 2							
Subject 3							
Subject 4							

Answers will vary, especially depending on data.

How might an athlete's vital capacity compare to a non-athlete? What about a child compared to a teenager or an adult? Explain your reasoning.

Answers will vary, especially depending on data. One would probably think that an athlete and an adult would have the largest vital capacity. Adults are taller and athletes are conditioned to high lung function.

Which factor (sex, height, age, activity level) has the greatest impact on vital capacity?

Answers will vary based on data.