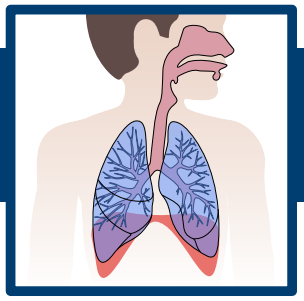
Teacher Notes

PULMO PARK
Lesson 2: *Respiratory Exploratory*



TEXAS BIOMEDICAL RESEARCH INSTITUTE
HEALTH STARTS WITH SCIENCE

1. **Teacher Background:** Within this lesson, students will engage in hands-on experiments which explore the impact the environment has on the components of the pulmonary system. Students will simulate various lung functions, gather data, and combine critical thinking skills with prior knowledge of the respiratory system structures to answer guiding questions associated with each activity and lab. These experiential labs have flexibility, meaning they can be conducted as stand-alone events to introduce or reinforce concepts. The experiments can be grouped or conducted in rotation. The Student Information provides important information for students to construct connections between the lab activities and the function of the respiratory system.

2. **Education Standards:** Identifies Texas Essential Knowledge and Skills (TEKS) and Next Generation Science Standards (NGSS). This lesson addresses:
   a. **TEKS:** High School – Biology, Anatomy & Physiology, Pathophysiology, Health,
   b. **NGSS:** Middle School and High School Life Science

3. **Activities & Exploratory Laboratories:**
   a. **Activity 2A: Expansion & Contraction**
      i. **Students will investigate** the question "what makes my chest expand and relax during breathing?" by creating a model of the chest cavity using a water bottle and balloon. Students will create drawings to depict and describe their observations. From these data, students will provide evidence to support their conclusion regarding the relationship between volume and pressure and how these factors impact respiration.
      ii. **Teacher Notes:** This activity can be done either individually (in the classroom or virtually) or as a group activity. Students will create a model by cutting a plastic water or soda bottle. The edges of a cut plastic bottle can be very sharp! Spend time reviewing the Safety Precaution with the students. Depending on students' ages and abilities, it may be beneficial to have a few bottles pre-cut. Sanding down the edges of the cut bottles can reduce the risk of cuts. In addition to creating a model, students will draw their model at different stages of the lab on the Processing Out. Much like scientists, students will pictorially represent and label their drawings to convey their observations. From their observations, students will analyze evidence to determine the relationship between volume and pressure as it relates to respiration.

   b. **Activity 2B: Under Pressure**
      i. **Students will investigate** the question "How do changes in volume affect lung function?". Using a syringe with plunger and a miniature marshmallow, students will observe the effect volume changes have on the marshmallow. Using this model, students will use their observations to generate a hypothesis which relate the model to the effect volume changes have on the lungs.

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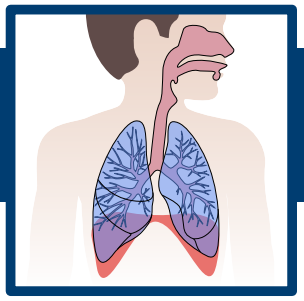

ii. **Teacher Notes:** This is a short activity which can be conducted in small groups or by individual students. Much like scientists, students will generate a hypothesis about the respiratory system and changes in volume based on observations from the model. Although hypotheses are generally taught as "if/then" statements, scientists do not use if/then statements. Students may use an if/then statement as a draft of their hypothesis. For example:

If/Then statement based on observation: If the plunger is pushed in, then the marshmallow gets smaller.

Hypothesis related to respiratory system: When the volume of the respiratory system increases, the pressure inside the lungs decreases.

Expanded hypothesis: When the volume of the respiratory system increases, the pressure inside the lungs decreases which facilitates inhalation (or which increases space between air molecules within the lungs or etc.).

Encourage students to expand their hypotheses to strengthen the connection between the model and actual lung function.

c. **Activity 2C: Tension – It's a Surface Issue**

i. **Students will investigate** the question how do the surfaces within the alveoli stay moist? Students will investigate the role surface tension and surfactants have in breathing. The inside of the alveoli are bathed in water, btu due to a phenomenon called "hydrogen bonding", water molecules attract each other, which creates issues inside the alveoli.

ii. **Teacher Notes:** Although this activity is short and relatively quick to assemble, the concepts can be complex. This activity demonstrates for students the connections between chemistry and biology. It may be necessary to spend time on the Student Background section in preparation for this lab. If students have had little to no exposure to chemistry concepts (molecular structure, types of bonds, atomic structure) it would be beneficial to use the Student Background as a pre-lab. Although the chemistry concepts may challenge some, it is important for students to make connections between content areas. Students will record their observations on the Processing Out. The questions can be used as prompts for class discussion or as group/individual response opportunities.