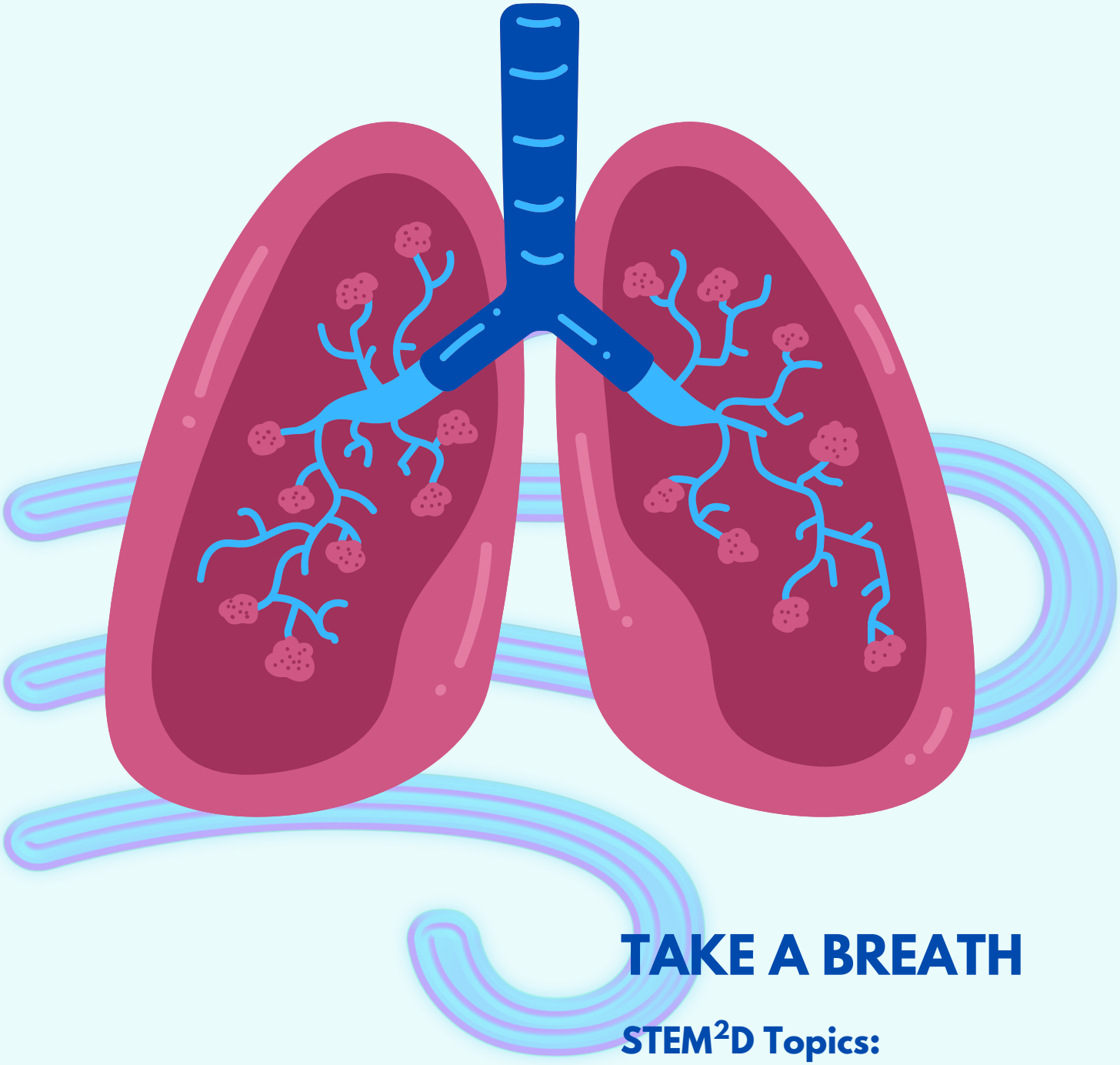
IGNITE ACTIVITY



TAKE A BREATH

STEM^{2}D Topics:
SCIENCE & ENGINEERING

Target Population:
Students, ages 8-14

TAKE A BREATH is part of the Student Activities Series developed by FHI 360 for Johnson & Johnson's WiSTEM^{2}D initiative (**W**inning in **S**cience, **T**echnology, **E**ngineering, **M**ath, **M**anufacturing, and **D**esign). The series features interactive and fun, hands-on activities for youth.

TAKE A BREATH

STEM²D Topic: Science & Engineering
Target Population: Students, ages 8-14

ACTIVITY DESCRIPTION

Learning how your lungs work when you breathe is important, especially since breathing is key to survival. We all take breaths - most of the time without even thinking about it! In this activity, students will create a working lung model to demonstrate how air goes in and out of the lungs, similar to the chest expanding and compressing with every breath.

ESTIMATED TIME

This session typically takes **15 to 20 minutes** to complete.

STUDENT DISCOVERIES

Students will:

- Learn how STEM²D – science, technology, engineering, mathematics, manufacturing, and design – subjects are connected to the healthcare industry.
- Build important STEM²D skills, such as exploring problems, critical thinking, collaboration, and intellectual curiosity.
- Consider STEM²D concepts including basic human body system functions and relationships between technology and healthcare.
- Have fun experiencing STEM²D!

GETTING READY

Materials:

- Pre-Activity Checklist
- Tell My Story Form, *optional*

STEM²D Skills

- Problem-Solving
- Critical Thinking
- Observation
- Collaboration
- Intellectual Curiosity

- Activity materials, 1 set of the following items per group:
  - 1 Empty, clear plastic one-liter bottle
  - 3 Latex balloons (2 small, 1 large)
  - 2 Flexible straws
  - Playdough or clay
  - Scissors of box cutter
  - Tape (duct tape of masking tape)

Estimated Cost:
Activity leaders can expect to incur $20 in materials costs per 15 students.

ACTIVITY LEADER PREPARATION

1. Read **Spark WiSTEM²D**. This is essential reading for all volunteers interested in working with youth, as it provides important background knowledge about STEM²D, strategies for engaging students, and tips for working with groups of students.
2. See the **STEM²D Student Activities Overview** for additional information.
3. Review the **Pre-Activity Checklist** (at the end of this document) for details and specific steps for planning, preparing, and implementing this activity.
4. If you have limited access to supplies or time scheduled with students is shorter than 15 minutes, consider providing a volunteer demonstration of how to build a working lung model to the entire group.

STEP-BY-STEP INSTRUCTIONS

1. **Welcome & Introductions (3 minutes)**
   - Greet the students as they arrive.
   - Tell the students your name, title, and organization/company.
   - Explain why you love STEM²D, and how your work is connected to various STEM²D areas.
2. **Learning Activity: Take a Breath (15 minutes)**
   - Explain that today students will build a working model of the lungs. Show the students the individual parts they will be using to create the lung model. *See Pre-Activity Checklist for more details.* Ask:

Engaging Students

- Circulate and answer questions during the building process.
- Check frequently for understanding by asking open-ended, topic-specific, or process questions.
- Encourage students to ask questions to gain deeper understanding.

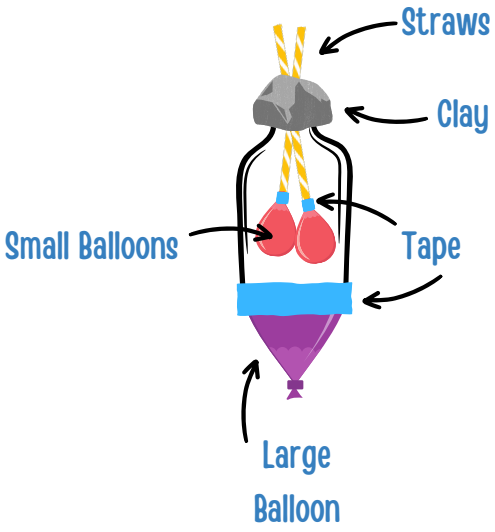
- Which of the 11 human body systems do the lungs belong to?
- What is the role of the respiratory system in our body?
- What are the different parts of the respiratory system?
- What is the primary responsibility of the lungs?

- Consider playing the following video that walks students step-by-step through the construction of the model. Pause the video after each step to allow students time to perform each task within their group.
  - bit.ly/STEM2Dlungs
- If you do not have access to technology during this session, walk students through the steps to build the lung model.
  - Insert a straw into one of the small balloons. Tightly tape the balloon around the end of the straw. Repeat this process for the second straw.
  - Using scissors or a box cutter, cut the bottom off of your empty 1-liter bottle.
  - Place the straws inside the bottle with the balloons toward the bottom of the bottle and the straws toward the neck of the bottle.
  - Using the clay, secure the straws to the opening in the neck of the bottle. Make sure the seal is tight and no air can enter or escape.
  - Pull down on the cut balloon taped to the bottom of the 1-liter bottle. As you pull down on the balloon, the two balloons inside the 1-liter bottle will start to inflate, mimicking your lungs.
- Explain what is happening inside the model.
  - In the Take a Breath lung model, the bottle represents the chest and the balloons inside of the bottle represent the lungs. The knotted balloon at the bottom represents the diaphragm.
  - Pulling the knotted balloon down represents the diaphragm contracting and flattening when you inhale, increasing the volume and decreasing the air pressure in your chest leaving more room for gas particles.

Helpful Hints

- The lungs belong to the respiratory system.
- The body uses the respiratory system to breathe in oxygen and exhale carbon dioxide.
- The respiratory system consists of several organs including the nasal cavity, pharynx, larynx, trachea, bronchi, bronchioles and lungs.
- The main function of the lungs is to provide oxygen to the blood and remove carbon dioxide from the blood.

See page 7 for a diagram of the respiratory system.

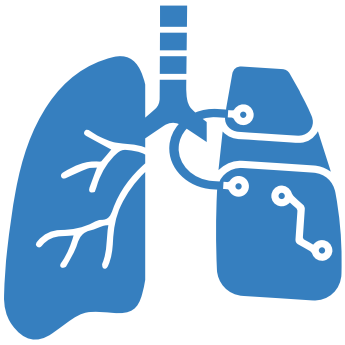


- This decrease in air pressure allows air to travel through the straws and into the ballons, filling the balloons with air, just like inhaling creates more volume in the chest cavity and allows air to flow into the lungs.
- When you exhale, the diaphragm relaxes, which decreases the volume and increases the pressure in your chest. This pushes the air out of the lungs. Similarly, when you push the knot inside the bottle, the volume decreases, and the balloon deflates by pushing the air out of the lungs.

3. **Student Reflection (2 minutes)**
   - Wrap up the activity by asking any of the following reflection questions:
     - What can you do to keep your lungs healthy?
     - How does the environment affect the respiratory system?
     - What are artificial lungs and why are they important?
   - Ask students to consider what kind of careers people with an interest/degree in this area would have. Examples include:
     - Health Care Occupations: Respiratory Therapist, Adult Critical Care Specialist, Registered Pulmonary Function Technologist, Neonatal/Pediatric Respiratory Care Specialist , Pulmonologist
     - Engineering Occupations: Biomedical Engineer, Bioengineer/Biomechanical Engineer, Mechanical Engineer, Materials Engineer, Clinical Engineer
     - Environmental/Air Pollution Occupations: Environmental Health Scientist, Epidemiologist, Toxicologist, Air Quality Specialist
   - Thank students for joining you today and encourage them to continue exploring careers in STEM²D.
     - Direct students to the Exploring Nursing Pathways eBook to learn more about careers in healthcare.
       - https://www.stem2d.org/navigating-nursing
     - Encourage students to take the STEM Career quiz and explore how a career in STEM²D can help to shape their future.
       - https://www.stem2d.org/stem2d-at-home

STEM²D Connections

- *Biology (Life Sciences):* Understanding the anatomy and function of the lungs.
- *Physics:* Modeling lung expansion and contraction and studying airflow and pressure changes during breathing.
- *Engineering:* Building lung models and creating diaphragm mechanisms to simulate breathing.



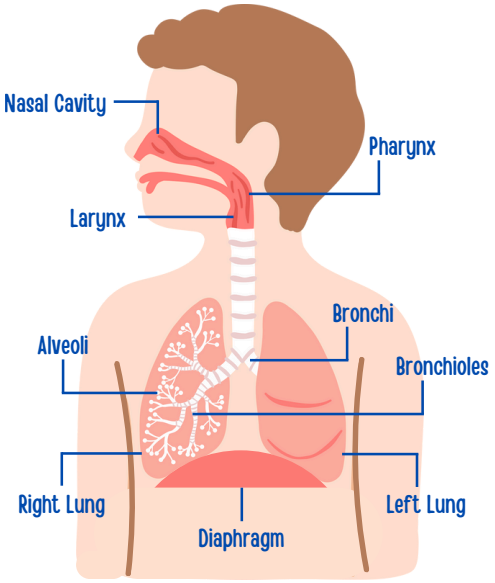
EXTENDED LEARNING

You can extend student learning by having students (or teams):

- **Experiment** with different health conditions.
  - What would happen if there was an obstacle in the windpipe (straws) that blocked air flow?
  - How would the respiratory system be affected if the balloons representing the lungs in the model were replaced with smaller balloons?
  - What would happen if the diaphragm (the knotted balloon at the bottom of the model) were punctured?
- **Encourage** students to explore what happens in the respiratory system when you sneeze, cough, or hiccup.
  - If time permits, consider playing the following short videos that explain what happens when you sneeze, cough, and hiccup.
    - Sneeze: What Happens to Your Body When You Sneeze? (youtube.com)
    - Cough: Why Do We Cough? (youtube.com)
    - Hiccup: Why Do We Get Hiccups? | COLOSSAL QUESTIONS (youtube.com)

KEY WORDS

- **Alveoli:** Balloon-like air sacs located at the ends of the bronchial tree and are responsible for moving oxygen into, and CO_2 out of, the bloodstream.
- **Bronchi:** The main passageway into the lungs. Bronchi help filter and trap foreign particles and pathogens.
- **Bronchioles:** Tubes in the lungs which branch off from the larger bronchi that enter each lung.
- **Diaphragm:** A thin, dome-shaped muscle that sits below the heart and lungs that helps with inhaling and exhaling.
- **Larynx:** A small organ in the top of the neck involved in breathing, swallowing, and talking. The larynx, or voice box, plays a vital role in the respiratory system by allowing air to pass through but blocking food from entering the trachea.
- **Lungs:** The most important organs of the respiratory system and are responsible for bringing fresh air into the body.



- **Nasal Cavity.** A large, air-filled space inside the nose. The purpose of the nasal cavity is to clean, moisten, and warm air as it moves to the throat.
- **Respiratory System.** Consists of organs and structures that allow us to breathe by taking in oxygen and expelling carbon dioxide.
- **Pharynx.** Part of the throat immediately behind the nasal cavity and the mouth that filters, warms, and moistens air as it travels toward the lungs.
- **Trachea.** A tube that carries air to and from the lungs, also known as the windpipe. It connects the pharynx and the larynx to the lungs.

RESOURCES AND REFERENCES

Activity concepts and real-life connections adapted from:

- Science Buddies, How Do We Breathe https://www.sciencebuddies.org/stem-activities/lung-model
- Teach Engineering, Creating Model Working Lungs: Just Breathe https://www.teachengineering.org/activities/view/cub_human_lesson09_activity1
- Kenhub, Human Body Systems https://www.kenhub.com/en/library/anatomy/human-body-systems

PRE-ACTIVITY CHECKLIST

TAKE A BREATH

*The following checklist helps activity leaders plan and prepare to conduct the **Take a Breath** activity with students.*

DID YOU . . .

- ☐ Read Spark WiSTEM^{2}D? This is essential reading for all volunteers interested in working with youth. It defines the STEM^{2}D principles and philosophy and provides research-based strategies and tips for engaging and interacting with students.
- ☐ Visit the event venue (optional) and/or finalize logistics with the organizer? Ask:
  - ☐ What is the date, time, and location of the event?
  - ☐ How will the room be arranged? Do I have access to tables? How big are they?
  - ☐ How many students do you expect? How will the students be organized/participate in the event? Knowing this will help you determine the quantity of materials to purchase.
- ☐ Recruit additional volunteers, if needed?
- ☐ Prepare for the activity? Did you:
  - ☐ Read the entire activity text prior to implementation?
  - ☐ Customize the activity, if desired, to reflect your background and experiences, as well as the cultural norms and language of the students in your community?
  - ☐ Complete the **Tell My Story Form**, which will prepare you to talk about your educational and career path with the students? *(optional)*
- ☐ Obtain the required materials? See the Materials and Estimated Materials Costs sections.
- ☐ Set up the site appropriately for the activity?
- ☐ Practice your presentation? *Make sure you can explain the concepts to students, if needed, and that you know the correct answers.*
- ☐ Bring a camera, if desired, to take photographs?
- ☐ Obtain and collect permission slips and photo release forms for conducting the activity, if applicable?
- ☐ Have fun!

TELL MY STORY FORM

This form will help activity leaders and other volunteers prepare to talk about their STEM²D interests, education, and career path.

ABOUT YOU

Name: _____

Job Title: _____

Company: _____

When/Why did you become interested in STEM²D? _____

_____

_____

What do you hope young people will get out of this activity?

_____

_____

FUN FACT

Share a little about your background. Ideas:

- Share a memory from childhood when you first had your "spark" or "interest" in STEM²D.
- Detail your journey, highlighting what you have tried, what you learned, steps to success, etc.
- Failures or set backs are also great to talk about—difficulties, and/or challenges, and how you overcame them.

EDUCATION AND CAREER PATH

What classes/courses did you take in secondary school and in college that helped or interested you most? _____

_____

How did you know you wanted to pursue a STEM²D career? _____

_____

What was your postsecondary path, including the institution you attended and your degree? If you switched disciplines, make sure you explain why. _____

_____

_____

What does your current position entail? Be sure to include how you use STEM²D during a typical work day. _____

_____

_____