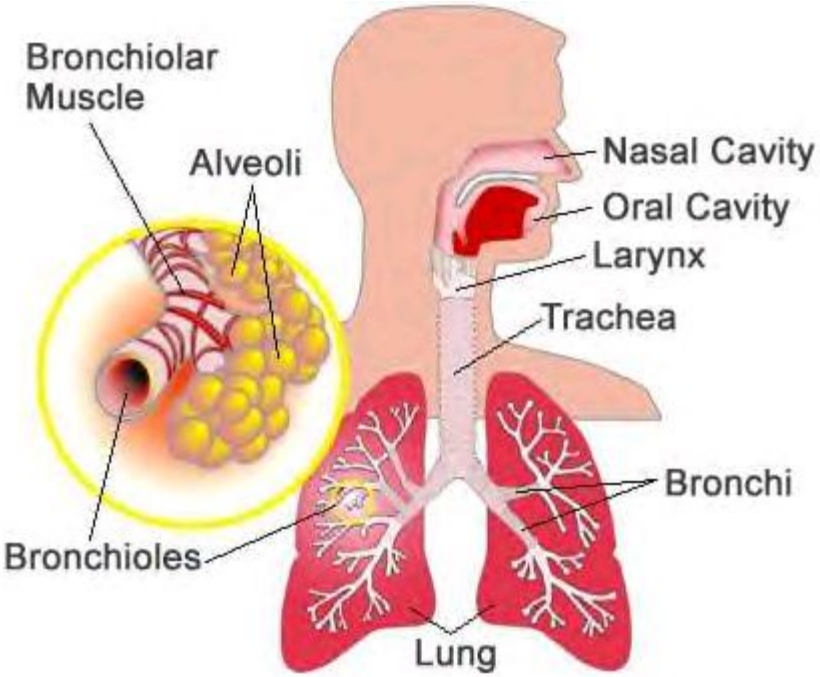
THE HUMAN RESPIRATORY SYSTEM

ACTIVITY UNIT FOR GRADE 7



http://www.medicinenet.com/alpha_1_antitrypsin_deficiency/article.htm

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This unit on the Human Respiratory System is based on the Science and Technology Concepts for Middle Schools Human Body Systems curriculum (National Science Resources Center and National Academy of Sciences, 2000). Some of the activities in the Human Body Systems curriculum were modified to achieve the same learning objectives through activities for which supplies were available (or could be readily obtained at a low cost) as well as available (e.g. the school's science lab is not equipped with gas).

The first four activities address the components of the human respiratory system and the general function of these components. This unit would be taught following a unit on the human circulatory system so that students would have background knowledge of the circulatory system and be able to use this knowledge as well as their own personal experience to look at how these two body systems interact with each other during the fifth activity for this unit.

Brief Description of Group to be Taught: This unit will be taught to 7th grade students who are grouped into 4 blocks with approximately 26 to 28 students in each block. The student blocks are consistent with the mathematics student groupings of pre-algebra (highly advanced), target (meet curriculum goals or are slightly advanced), level (slightly below or meeting curriculum goals), and inclusion (everybody else). There are a number of students with IEP plans (ADD and/or ADHD, and one student with an allergy to powdered latex materials); these students are placed for the most part in the level and inclusion groups.

Massachusetts Frameworks Strand and Learning Standard:

Strand 2 - Life Science/Biology

Learning Standard 6 – Systems in Living Things:

- General functions of the major systems of the human body: respiration, circulation, movement, and coordination; and
- Describe how these systems interact with each other.

Strand 4 - Technology/Engineering:

- Engineering Design Process – using models and evaluating their strengths/weaknesses.

Activity #1

Relationship of this Lesson to the unit: This lesson was designed to introduce the human respiratory system with a launching activity and preliminary assessment to understand what the students already know about the human respiratory system. Following the unit introduction, the student will conduct a website exercise to investigation computer models of the respiratory system. This is followed by an inquiry exercise using one type of hands on model (syringe model) to simulate the mechanics of breathing. This activity is linked to the Massachusetts Frameworks Strand 2, Learning Standard 6 regarding the general function of the human respiratory system. The inquiry activity using the syringe model also relates to Strand 4 for technology and engineering.

Concepts:

- Breathing is the mechanical process of air moving into and out of the lungs;
- Two stages of breathing: inhalation and exhalation;
- Role of muscles (intercostals and diaphragm) with changes in chest cavity volume and air pressure in the movement of air into and out of the lungs;

Processes:

- Modeling

Science Habit of Mind:

- Persistence in completing a task

Session Length: Two to Three 50 minute periods

Materials Needed: (Per group of 4)

- Individual student science notebooks;
- 2 large, plastic syringes with ends removed;
- 2 round balloons, 9 inch;
- 2 beakers, 400 ml; and
- Access to a sink for water.

TIME	PROCEDURE	PROCESS
Day 1 Before class	Make a transparency of the human respiratory system diagram with the labels removed; make copies of unlabeled human respiratory system diagram; make copies of modeling worksheets. Make arrangements to use computer lab or library to have sufficient computers for web exercises. Make up 14 sets of materials.	
40 minutes	Introduction: Make the students aware that they are beginning a new unit. Possible launching activities include using a piece of video where a person's breathing rate increases because of exertion, or invite a couple of speakers in to the class who use equipment in the work or hobbies that affect their breathing (e.g. firefighter, emergency response personnel, scuba diver, mountain climber). Conduct a classroom discussion linking back to the launch activity to assess what the students already know about the human respiratory system. Example questions: • What do you know about lungs? • What do you know about breathing and respiration? • What are some of the body parts and elements involved in breathing? • Why do you think you breathe faster when you exercise? • How do you think using a respirator or diving mask affects your breathing? • Do you know something about how much oxygen is in the air and how changes in altitude (mountain climbing) could affect your breathing? • Have you heard of the respiratory system before? • Why do you think it is called a system? Record responses on chart paper (K-W-L)	Communicating Questioning Inferring

10 minutes	Introduce Driving Question (or a modified version based on student input): How does the respiratory system work? Explain to students that tomorrow they will be visiting two websites to learn more about respiration as a prelude to building models. (Note: if launch is a short film, the class setting for Day 1 into Day 2 could be in the school library or computer lab.) Assign Homework: Journal reflection on launch activity: What types of careers are you thinking about? What kinds of activities do you enjoy? Can you think of any ways that these careers/activities are affected by the well being of your respiratory system? If you don't think your activities involve the respiratory system, explain your thinking.	Making Connections
Day 2 40 minutes	Class introduction: Ask students if any of them want to share their journal reflection. Bring students to computer lab or library – bring their notebooks and unlabelled sheets and modeling worksheet. Ask students to sketch a diagram showing what they know about the respiratory system. Have students visit the website http://www.lung.ca/children/grades7_12/index.html (*Inside the Human Body: The Respiratory System*). This site provides a basic overview on lungs and lungs as a system. It shows how lungs are made up of many parts and that all are important for the lungs to work right. Also have students visit the website http://www.thinkquest.org/library/websitena.html?5777 (Welcome to the Respiratory System). This site provides a closer view of the lungs. Specific text on lungs, inputs, and outputs are mentioned (breathing in oxygen, breathing out carbon dioxide). Students will review their worksheets and make revisions to their first drawing based on the models they investigated on the web sites.	Recording Revision/Change
10 minutes	Reconvene in the classroom for a facilitated discussion as a follow-up to the web site investigation. Have an overhead with an unlabeled diagram of the respiratory system shining on a dry erase or blackboard. Students can come up and label parts on the diagram. Example facilitative questions: • What changes did you make to your first sketch of the respiratory system? • How would you compare the first website model of respiration to	Making connections Modeling Cooperative learning

	the second website model? • Is one model better than the other? • What is the difference between a model and a system? • With what systems are you familiar? How would you define a system? • What is the function of the respiratory system as a whole? • What are the essential parts of the system? • What are the functions of these parts? • Would the individual parts of the lung be able to function alone? Why or why not? • Do you think it is important to have all the parts of the lung together in a certain way? Why or why not? Quick write before leaving classroom or homework journal assignment: Have any of the questions in the "want to know" column been answered? Write down at least one new question that you have after completing today's activities and explain how it relates to our driving question.	
Day 3 **Day 4?** 10 minutes	Continue discussion from previous day. Update our K-W-L chart. Tell students that now they will work with some materials and design a model of the respiratory system.	Making connections
30 minutes	Students will work in pairs. One student in each group will be the Getter and pick up the materials. Allow the students 10 minutes to experiment with the equipment and to start working with their partner to write down a design for a lung model. Facilitating questions: • What item in your kit could be used to model the lungs? • How many lungs do we have? What is different about your model? • What part of the syringe can be compared with the chest cavity? The diaphragm? The mouth or nose? • Would the model work with air or water? • Why is water used in this model? Do you think our lungs are wet or dry? Student pairs begin to construct their models, keep record of how they put it together, what "works", and compare to their design ideas. Eventually, one pair of students will assemble the model with the balloon lung inside the syringe – students can model this for others.	Messing around Predicting Inferring

10 minutes	Classroom discussion as a follow-up to the syringe inquiry activity. Refer to overhead with diagram of the respiratory system the dry erase or blackboard. • Why do you think the balloon inflates/deflates when you move the syringe? (Do students make the connection to changes in volume and pressure in and outside the chest cavity? May lead to a benchmark lesson on pressure and volume).	Synthesize Cooperative learning

Activity #2

Relationship of this Lesson to the unit: This is the second inquiry activity in a unit made up of five activities. This lesson was designed to help students confirm their new knowledge of some of the general functions of the human respiratory system (Learning Standard 6 of the Life Science/Biology Strand 2) by having the students conduct an inquiry exercise to construct a different type of model to simulate the mechanics of breathing.

Concepts:
- Breathing is the mechanical process of air moving into and out of the lungs;
- Two stages of breathing: inhalation and exhalation;
- Role of muscles (intercostals and diaphragm) with changes in chest cavity volume and air pressure in movement of air into and out of the lungs; and
- Models have strengths and limitations.

Processes:
- Modeling.

Science Habit of Mind:
- Open mindedness; flexibility to look at same problem in different ways.

Other Subject Area Objectives:
This lesson is also linked to Strand 4 of the Technology/Engineering curriculum frameworks. The students will use a variety of materials and media to construct a model to demonstrate the concept and evaluate the effectiveness of the model.

Session Length: One 50 minute period

Materials Needed: (Per group of 4)

- 2 12” balloons;
- 1 15” balloon or 1 x 1 quart plastic bag;
- 2 straws;
- 1 2 liter plastic bottle with the bottom removed;
- 5 cotton balls (100% cotton);
- Regular clear tape - one dispenser per group; and
- Student science notebooks with their sketches of the respiratory system.

TIME	PROCEDURE	PROCESS
Before class	Prepare the plastic bottles by washing them and cutting off the bottoms; cut the round end off of the 15" balloons; cut the zipper locks off the plastic bags. Make up 7 sets of materials and place them on a table for the first block of students.	
10 minutes	Introduction: Explain that the students will be using the materials provided to build a different model that can be used to explore the mechanical breathing process. Divide students into groups of 4 and assign/explain roles: Getter, Starter, Recorder, and Reporter. Have Getters collect the materials for their group.	Roles and groups
20 -25 minutes	Have the students work in their groups to manipulate the materials, design their model, record trial/error in building the model – they should have their modeling sheets from the previous activity for reference. Once they have completed the model discuss within their groups their observations on the function of the model and infer how the model relates to breathing mechanics.	Cooperative learning Problem Solving Modeling Inferring
15 - 20 minutes	Classroom discussion to reflect on modeling activities. Example questions: • Did your model work as planned/designed? • What changes did you make? • How could you improve the model? Link back to our driving question and K-W-L chart. What have we confirmed about what we already knew; did we answer questions in the "want to know" column? Any new questions? Assignment: Write journal reflection on modeling activities: describe the strengths and limitations of the lung model constructed in class today and the syringe model (previous activity). How is each model similar to the human respiratory system and how are they different?	Making connections Synthesizing
Allow for flexibility in conducting/completing activities 1 and 2 – Can introduce concept mapping (see below) where it fits in after web site investigation or either lung modeling activity.		
	Introduce concept mapping (benchmark lesson): • Can anyone tell me what they think a concept map is? • What is a concept in science? Is a concept a thing or a process (how something works)? • What do we use maps for? Do maps show us which way to go? •	Spatial relationships Making connections Synthesizing

	• Can we use concept maps to explain what we know about how the respiratory system works? Model the beginnings of a concept map – have students participate and start drawing the map on chart paper.	

Activity #3

Relationship of this Lesson to the unit: This is the third activity in a unit made up of five activities. This lesson was designed to allow students to discover that lungs have a large internal surface area with millions of tiny sacs called alveoli. The alveoli enable the lungs to hold large amounts of air, and therefore a large volume of oxygen to support the activities of all the body cells.

Concepts:
- Lungs have a large internal surface area;
- Lungs are elastic and can hold different volumes of air.

Processes: Measuring

Science Habit of Mind: Revision and change

Session Length: One 50 minute period

Materials Needed: (Per group of 2)

- Student science notebooks;
- 2 pieces of compressed (dried) sponge;
- 1 graduated cylinders, 50 ml;
- 2 beakers, 250 ml;
- 1 pair of dissecting forceps; and
- Water or access to a sink.

TIME	PROCEDURE	PROCESS
Before class	Cut sponges in pieces of equal size; one sponge for each student; will need enough for each student for the entire day of classes so the sponges are dry/compressed to start the activity (and some spare sponges to allow students materials to conduct procedure design with trial/error).	
10 minutes	Introduction: Looking at another model of the lungs to learn something new about the respiratory system – a sponge and water. • What do you already know about sponges (how they work)? • If water will make the sponge expand (get bigger), can you relate that to what happens to our lungs when we inhale? (hypothesize)	Making connections hypothesize

25 minutes	Students will work in pairs. One student in each group will be the Getter and pick up the materials. Ask students to examine their materials. • How do you think you can measure how much water is soaked up by a sponge? Students to design/write out a procedure to determine how much water is soaked up by their sponge. Experiment with the first sponge. Ask students to model for the class how they designed a procedure to measure the amount of water absorbed by the sponge. Student pairs make any corrections to their procedure and redo experiment with the second sponge and record the amount of water absorbed by the sponge. (Note: may need to review with students how to read a graduated cylinder.) • How can you measure how much water you can squeeze out of the sponge? Students to record measurement of volume of water squeezed out of the sponge and compare this measurement to the total amount of water absorbed by the sponge. Quick write in their notebooks to respond to this prompt: • Does the amount of water absorbed by the sponge equal the amount squeezed out of the sponge?	Measuring Revision/change Inferring
15 minutes	Classroom discussion to reflect on the sponge model. Example questions: • Was the sponge still wet after you squeezed out as much water as you could? Why or why not? • What do you already know about sponges that explains why the sponge is still wet after squeezing it “dry”? • Which amount of water represents the amount of air you could forcibly exhale after taking a deep breath? • Which of these amounts represents the air you could not forcibly exhale from your lungs? • Which of these amounts of water represents the total amount of air your lungs can hold when you take your deepest breath? • Do you think you exhale all of your air during breathing?	Modeling Inferring Making connections

	Homework journal assignment: We used a model that compares a sponge to the lungs. Sponges have a large internal surface area (lots of tiny holes that hold water). Our lungs aren't very big – how can they have a large internal surface area? Why do our lungs need to have a large internal surface area?	

Activity #4

Relationship of this Lesson to the unit: This is the fourth activity in a unit made up of five activities. This lesson was designed to teach students some of the general functions of the human respiratory system (Learning Standard 6 of the Life Science/Biology Strand 2). Students will explore several aspects of lung capacity: vital capacity (how much air they can exhale after a deep breathe); total lung capacity; and residual volume. Students will investigate some of the factors that influence vital lung capacity. Prior knowledge that the students would need to complete this activity would include the concept that air takes up space or volume; the students would need to understand the concept of volume and how it is measured. A benchmark lesson on data recording and graphical representation could be inserted prior to this activity if the students do not have prior experience in data collection and interpretation.

Concepts:
- Lungs are elastic and can hold different amounts of air (normal vs. deep breaths); and
- The amount of air the lungs can hold is affected by many factors (internal and external)
- Vital lung capacity plus residual lung capacity equals the total lung capacity (e.g. do we exhale all of our air?).

Process:
- Recording data.

Science Habit of Mind:
- Keeping good records of data.

Session Length: Two 50 minute periods

Materials Needed: (Per group of 4)

- 1 quart wide-mouth jar;
- Bucket;
- Cardboard;
- Rubber tubing (1 section of tubing for each student);
- Ruler;
- Graduated cylinder;
- Wax marking pencil;
- Paper towels; and
- Student science notebooks to record observations and data.

TIME	PROCEDURE	PROCESS
Before class	Gather enough materials for 7 groups of 4 children and place them on a table for the first block of students. Bring in containers with water from the laboratory if there isn't a sink in the classroom.	
10 minutes	Review the journal assignment from the previous activity – ask students to share their responses. • Why do our lungs have a large internal surface area? • How many alveoli do our lungs have? Why? • How does this relate to our driving question? Explain that the students will be using the materials provided to measure the volume of air that they exhale during normal breathing and also when they take a deep breath. Divide students into groups of 4 and assign/explain roles: Getter, Starter, Recorder, and Reporter. Have Getters collect the materials for their group.	
25 minutes	Directed Inquiry: Have the students see what happens when the submerge an empty jar in the buckets of water (air bubbles; water displaces the air in the jar); Then have the students place jars filled with water upside down in their buckets, which have 6 cm height of water in the buckets and let them explore what happens when they tilt the mouth of the jar slightly off the bottom of the bucket. Ask if they can think of another way to get the water to move out of the jar…ask other facilitative questions to have the students move toward thinking of a way to use this setup to measure the amount of air in our lungs.	"Messing Around"
15 minutes	Students in each group take turns measuring their lung volumes for shallow and deeper breaths.	Data collection

Continuing the investigation: Day 2

The students would continue the inquiry activity on Day 2 – they may refine their work if they felt they needed to conduct a few trials per person to obtain a representative result for each group member's lung volume for normal and deep breaths. Review the graphs/charts made for homework and have a class discussion on ways to show the data collected.

Students could brainstorm other data comparisons using the data the class collected during the inquiry activity (e.g. variations in lung volumes between boys and girls, athletes and non-athletes, students with allergy/asthma and those without these health issues). Students could design a chart for the blackboard that would have the averaged result for lung volumes using shallow and deep breaths for all of the students and add columns to track the other data of interest. Students could then work in pairs to design graphs to represent the data they are interested in and write down what they feel could be inferred from the graphed data and then present this information to the class.

Class discussion:
Ask facilitative questions: Was there any difference in the lung volume measured for shallow vs. deep; did anyone measure their lung volume more than once – why?

Assign Homework:
Each student will make their own chart or graph with the data from their group.

Formative Assessment Rubric

	Novice	**Competent**	**Expert**
Process Skill	Not able to record data in an organized manner.	Able to record data in an organized manner.	Able to record data in an organized manner and make connections between observations/data and own life experience.
Habit of Mind	The data recorded is not complete, accurate, or neat.	All data is recorded and accurate.	All data is recorded and accurate. Data is presented in a clear and organized chart format and is easily understood by other students during group presentations.
Concept	Does not understand that lungs are elastic and can hold varied amounts of air, and that the volume of air that can be held is related to many factors.	Understands that lungs can hold varied amounts of air (e.g. deep and normal breaths) but does not connect this to other factors or consider the concept of total lung capacity.	Understands that lungs are elastic and can hold varied amounts of air, and that we don't exhale all of our air (residual lung capacity). Able to make the connection to the relationship between lung volumes and other physical and environmental factors and shows creativity in evaluating data.

Activity #5

Relationship of this Lesson to the unit: This is the fifth activity in a unit made up of five activities. The students will design and conduct an investigation to determine the effect of exercise on breathing rate. The students will be gain an understanding of how the respiratory system and circulatory system work together; this activity directly corresponds to the requirement that students learn about the major systems of the human body and describe how these systems interact with each other (Learning Strand 2 for Life Science/Biology and Learning Standard 6). The students will also investigate internal and external factors that contribute to breathing rates for individuals and related health effects. This activity also incorporates data collection and analysis, and presentation.

Concepts:

Human body systems interact with each other

Processes:

Identifying and controlling variables as part of designing and conducting an inquiry

Science Habit of Mind: Data collection

Session Length: Two 50 minute periods

Materials Needed: (Per group of 4)

- 1 stopwatch per group;
- Graph paper; and
- Student science notebooks to record data.

TIME	PROCEDURE	PROCESS
Before class	Rearrange the desks in the room so students will have sufficient space to conduct the activity in their small groups. Gather stopwatches and graph paper.	
10 minutes	Brainstorm and record responses on chart paper (K-W-L) on how the respiratory and circulatory systems may be linked.	Communicating Inferring
15 to 20 minutes	Students work in groups of 4 (Getter, Starter, Recorder, and Reporter). Have Getters collect the materials for their group. Students to outline their procedure for conducting an investigation to determine the effects of exercise on their breathing. Review group procedure design with the teacher. Address teacher comments within the group; revise or adjust procedure if needed.	Roles and groups Cooperative learning Problem Solving Communicating Identifying and controlling variables
15 to 20 minutes	Have getter obtain a stopwatch from the materials area and conduct the designed inquiry. Each student will prepare a tabulated summary of the data and graphically present the data. In your groups, discuss what else you may have observed while the inquiry was being conducted in addition to recording breathing rates.	Recording Inferring
5 minutes	Assign Homework Journal reflection on inquiry activity: What are the variables you identified when designing your inquiry assessment? How did you decide which variables to control during your inquiry? Explain how you designed the inquiry procedure if you didn't identify any variables.	Identifying and controlling variables

	Day 2: Regroup into groups of 4 and continue data collection if needed. Each student will prepare a tabulated summary of the data and graphically present the data. In your groups, discuss what you observed have observed while the inquiry was being conducted in addition to recording breathing rates.	Recording Inferring
STILL NEEDS MORE DETAIL	Assessment Assignment: Create an artifact: Have students create a "Wanted" Poster for a particular component of the respiratory system; another option could be preparing a Travel Brochure for the respiratory system. This will be worked on in one or two class period and at home. Students will present their project to the class. This activity will incorporate self assessment using a guided journal prompt to help them evaluate their level of understanding. Students will also make any revisions and update their concept maps.	