SCIENCE NORTH SCIENCE NORD
SUDBURY, ONTARIO, CANADA

The Respiratory System **Grade 11 – Anatomy of Mammals**

Lesson Plan

Assessment	AFL, AOL (Exit Card)
Cross-curricular	Phys. Ed

Big Ideas

- Groups of organs with specific structures and functions work together as systems, which interact with other systems in the body.
- Technologies that are used to maintain human health have social and economic benefits and costs.

Learning Goals

- I know and can identify the key terms inhalation, exhalation, nose, nasal cavity, larynx, epiglottis, trachea, bronchus, bronchiole, and lung.
- I can demonstrate how the motion of the diaphragm controls breathing.
- I know that 3D printing is a new technology that can be used to replace or repair parts of the respiratory system.

Specific Expectations:

E1.1 analyse the social or economic impact of a medical device or technology related to the treatment of the human circulatory, respiratory, or digestive system (e.g., a pacemaker, a heart/lung bypass machine, kidney dialysis)

E3.2 describe the anatomy and physiology of the respiratory system (including the nasal cavity, trachea, larynx, bronchi, bronchioles, alveoli, and oxygenated and deoxygenated blood) and the mechanisms of gas exchange and respiration infection of the skin, treated with fungicides)

Description:

In this lesson students will make a model of the respiratory system with everyday items. Students will also learn about respiratory diseases and how 3D printing technology can repair parts of the respiratory system. **This lesson is intended for the college level**.

Materials

World's Most Asked Questions: How Can I Get Rid of Hiccups video
Meet the Lungs video
Parts of the Respiratory System
Model of the Lungs Materials:

- A clear plastic 2 litre bottle with the bottom half cut off
- Two straws
- Two balloons
- Masking tape (or black electrical tape)
- A rubber band
- A piece of plastic bag

Lung Volume Materials:

- Clean plastic tubing
- A clear plastic 2 litre bottle or graded plastic cylinder
- A large water basin or sink
- Water

Safety Notes

Be careful when using scissors to cut the bottom half of the 2 litre bottle.

Introduction

Think for a moment about what you do when you have the hiccups…
Now share your best hiccup remedy with your elbow partner. The teacher will make a list of class cures on the board.

Discussion Questions:
Do they have anything in common? Do some seem scientific or are some just downright weird? Who has the strangest cure for the hiccups? What makes us hiccup and what can we do to stop them?

Please watch video "World's Most Asked Questions: How Can I Get Rid of the Hiccups?" to learn more about hiccups https://www.youtube.com/watch?v=e0oELHA6EvM.

In this lesson, we will learn about the anatomy and physiology of the respiratory system as well as ways in which new technology is allowing researchers and medical practitioners to either replace or repair some parts of the respiratory system, or practice complicated procedures on 3D printed parts.

Students will get an overview of the respiratory system and can fill in the Parts of the Respiratory System (see Link) either while the video is playing or afterward. The class should take up these responses together so that students can use the diagram for their own notes.

Watch video from Khan Academy Meet the Lungs
https://www.youtube.com/watch?v=qGiPZf7njqY
to learn more about the anatomy and physiology of the respiratory system as you fill in Parts of the Respiratory System for your notes.

Action

In this activity, we will build our own model of a lung to see how the diaphragm controls breathing and test our own lung capacity. Find a partner to make this demonstration easier.

You will need:

- A clear plastic 2 litre bottle with the bottom half cut off
- Two straws
- Two balloons
- Masking tape (or black electrical tape)
- A rubber band
- A piece of plastic bag

1. Insert a straw into one of the balloons and secure the balloon to the straw using tape. Repeat this step using the second straw and balloon.
2. Insert both balloons into the 2-litre bottle. Leave the straws sticking out and tape them to the bottle top. Wrap the tape around so that around the straws is air-tight.
3. Secure the piece of plastic bag to the bottom half of the 2 litre bottle using the elastic.
4. Tape a little piece of paper to the bottom of the plastic bag to make a tag that you can pull.

Can you identify the anatomy of the respiratory system on your model? Next, pull the little tab on the bottom of the plastic bag. What happens? How does this model represent what happens in your circulatory system?

Adapted from: http://kartwheels.org/2013/09/21/make-a-lung-model-out-of-a-plastic-bottle-straws-balloons/

Next, we will compare lung volumes.

You will need:

- Clean plastic tubing
- A clear plastic 2 litre bottle or graded plastic cylinder
- A large water basin or sink
- Water

1. Fill the basin or sink with approximately 10 cm of water.
2. Fill the plastic bottle or cylinder to the top with water and then place your hand on top. Tip the container into the basin without allowing water to run out or air to enter.
3. Place one end of the plastic tubing into the container.
4. Take the deepest breath possible.
5. Blow all of the air you have just inhaled into the plastic tubing.

You can compare your lung capacity to your partner's. For a more quantitative comparison, the entire class should use identical cylinders and can record how many milliliters of water they have

displaced with their exhalation. You will want to wipe off the plastic tubing using an alcohol wipe between each person.

Who has a greater air capacity (or VO_2 max)? Does size seem to affect your air capacity?
Who would have a greater air capacity: a smoker, a runner, or an opera singer?

Assessment for Learning:
The teacher can circulate while students are putting together their models of the lungs to ask students to identify the different parts of the respiratory system.

Plastic bottle = rib cage
Balloons = lungs
Straws = bronchioles
Plastic bag = diaphragm

The teacher can also ask the students to explain how we inhale and exhale by expanding and contracting the diaphragm.

All students can then compare their lung capacities and discuss reasons why some students may have greater lung capacities than others. Musicians who play wind instruments, singers, and athletes may all have greater VO_2 Max.

Consolidation/Extension

You may know of many diseases of the respiratory system. There is, of course, lung cancer, which is often caused by smoking, but there are other serious diseases such as asthma, bronchitis, chronic obstructive pulmonary disease (COPD), pneumonia, emphysema or cystic fibrosis.

What about a two-year old girl, born without a trachea? Or a child born missing a pulmonary valve, causing his airways to collapse? These are congenital defects that can be addressed by replacing or repairing missing parts. The first child received a windpipe built with her own stem cells, and a biomedical engineer created a splint to expand the second child's airways.

In medicine, 3D printing is now being used to make prosthetic limbs or models of a patient's body to use as a guide during surgery. Scientists are investigating ways to print replacement organs and tissues using living cells.

Please watch this video by CNN about 3D Printing of organs to see how science and technology can help.

CNN: 3-D Printer Produces Organs
Dr. Anthony Atala
https://www.youtube.com/watch?v=N5xQB7Rgd98&feature=youtu.be
Posted July 10, 2011.
Retrieved, January 1, 2016

Read the article "Lungs on a chip, 3-D printed hearts: The shape of medicine to come" learn more about research into printing organs.

http://www.cnn.com/2014/03/12/opinion/lungs-chip-3d-print-organs/index.html
posted March 13, 2014
Retrieved January 1, 2016

Exit Card

1. Explain one difficulty scientists may have with printing full organs.
2. How may 3D printing be used in medicine in the future?