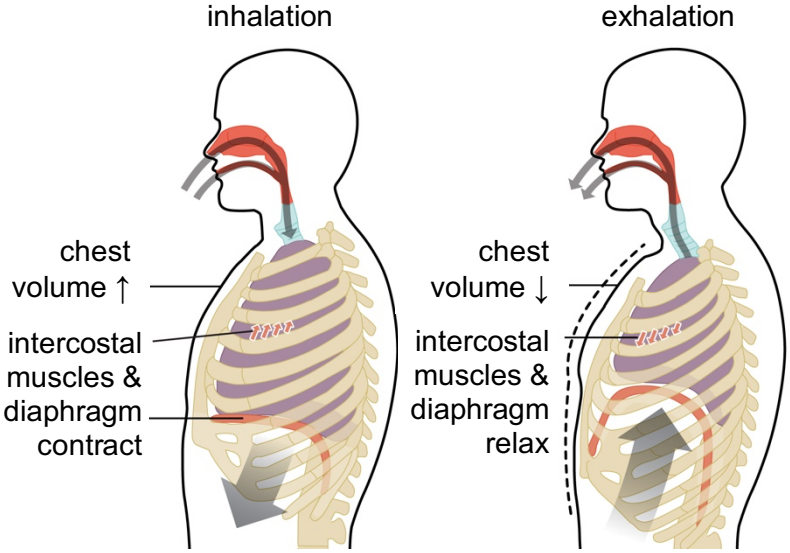
3 Ventilation & COVID-19

Links:
• *Exploring Science WS* 7Ca, 8Cb

Breathing and ventilation

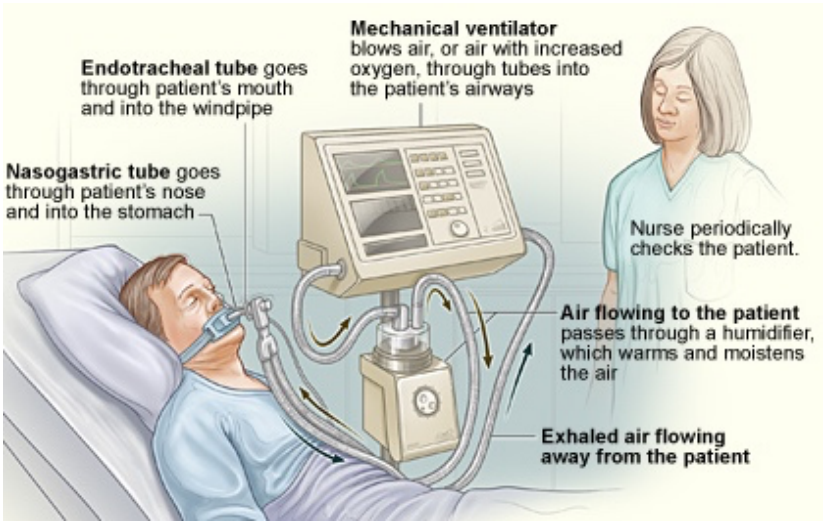
When **intercostal muscles** contract, they shorten and pull up the **ribcage**. When **diaphragm** muscles contract, it flattens. These movements increase the volume of the **chest**.



As volume increases, pressure decreases. Now, air flows from the higher pressure in the surroundings to the lower pressure in the chest, where it fills the lungs (**inhalation)**. **Exhalation** happens as muscles relax (the rib cage falls, and elastic fibres make the diaphragm rise).

This movement of muscles is **breathing**, and the flow of air is **ventilation**. Lungs are not attached to the ribs or chest. They inflate and deflate due pressure differences moving the air in and out of them.

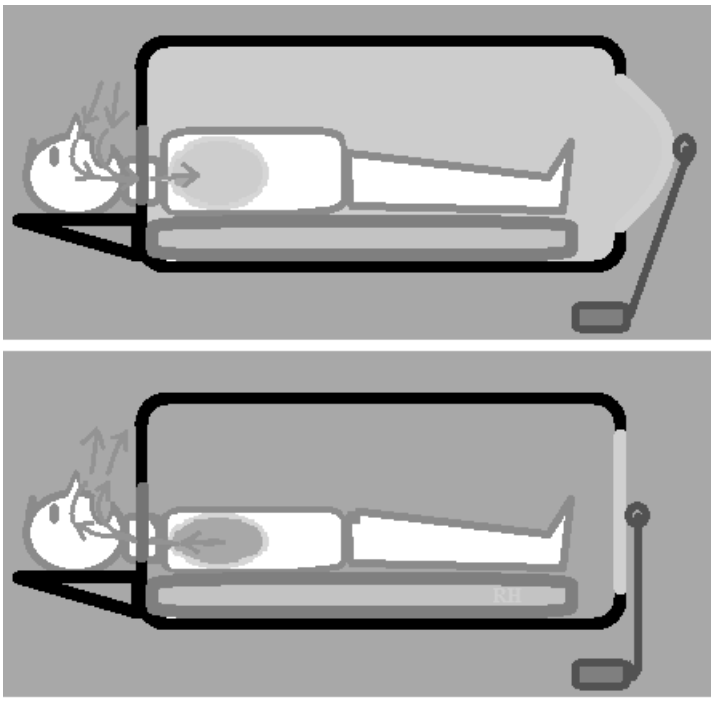
In very serious cases of COVID-19, the lungs fill with fluid. It takes a greater pressure difference to get the heavy lungs to inflate; normal breathing movements are not enough. So, a tube is put into a patient's trachea and a machine generates a large pressure to cause air to flow into the lungs. The machine generates a higher pressure than inside the chest, and so is a 'positive pressure' **ventilator**.



Find out

1. a. 'Iron lung' ventilators were used in the 1950s. Use sciencemuseum.org.uk to find out why.

b. An ‘iron lung’ is a negative pressure ventilator. Label the diagram to explain how it works.



Test yourself

decrease	exhalation	
falls	higher	equal
increase	inhalation	
intercostal	lower	
rises	surroundings	

2. Complete these sentences using *some* words from the box.

When _____ muscles relax, the ribcage _____. When the muscles in the diaphragm relax, it _____. These movements _____ the volume of the chest. Air flows from the _____ pressure in the chest to the _____ pressure in the surroundings. This is _____.

3. Explain why a patient with the most serious form of COVID-19 finds it difficult to breathe.

_____

_____

Check-up

I. Check your answers.

II. Design a way to model how the lungs works. Use two party balloons and a strong, clear, see-through plastic drinks bottle with the bottom cut off.

Answers

Note to home educators

The worksheet is designed to support understanding of breathing. You may wish to share these objectives with students:

- Describe how muscles attached to ribs and in the diaphragm produce breathing movements and ventilation
- Use a model to explain how lungs expand and contract.

Students need a basic knowledge of the breathing / respiratory system to access this sheet.

It is suggested that students complete the worksheet independently, making use of the internet to complete question 1. Questions 2 and 3 should be completed without help from additional sources.

If you wish to check the answers, keep this part of the sheet away from the questions!

I. 1. a. They were used to help people with polio, a disease that stopped muscles (including breathing muscles) from working properly.

b. When the lever on the right pulls on the sheet at the end of the iron lung, the volume inside the iron lung increases. This decreases the pressure. Air flows from higher pressure in the surroundings, towards the inside of the iron lung. The air enters the lungs and inflates them. The reverse happens when the lever moves the sheet back.

2. intercostal, falls, rises, decrease, higher, lower, exhalation.

3. Fluid collects in the lungs, making them heavy. So, the pressure difference that the body can generate (between the inside of the chest and the surroundings) is no longer large enough to inflate them properly.

II. You may be shown a design for a model lung. There are good videos showing how to do this on the internet. Search for ‘make simple lung model with balloons’.

⚠ Note that some videos show the use of a scalpel to cut a bottle.

The important feature is that when the lower balloon (representing the diaphragm) is pulled down, the balloon inside the bottle (representing a lung) inflates slightly. When the ‘diaphragm’ is pulled down, it reduces the air pressure inside the bottle. Air flows from the surroundings into the bottle, where it goes into the ‘lung’.

For additional challenges, you could ask:

• How is this a good model for how ventilation works? How is this a poor model?

• How could the model be adapted to show the effect of a positive pressure ventilator?