**Muscles in organ systems**

**The digestive system**



An apple in a sock can be used as a model of how food moves through the human digestive system.

**To talk about in your group**

1. What does the apple represent?
2. What does the sock represent?
3. What do the stripes on the sock represent?
4. How can the model be used to explain how food is moved through the human digestive system?
5. Are there any problems with the model?

**Muscles in organ systems**

**The gas exchange system**

glass tube

bung

balloon

bell jar

sheet of rubber

A balloon in a bell jar can be used as a model of how humans move air into and out of their gas exchange system.

**To talk about in your group**

1. What does the balloon represent?
2. What does the bell jar represent?
3. What does the sheet of rubber represent?
4. How can the model be used to explain how humans move air into and out of their gas exchange system?
5. Are there any problems with the model?

*Biology> Big idea BCL: The cellular basis of life > Topic BCL2: From cells to organ systems > Key concept BCL2.3: The human skeleton and muscles*

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| --- |
| **Response activity** |
| **Muscles in organ systems** |

**Overview**

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| Learning focus: | Bones and muscles are tissues that work together with organs in organ systems to support the life processes of cells to keep organisms alive. |
| Observable learning outcome: | Explain the presence and roles of muscles in organs and organ systems. |
| Activity type: | Critiquing a representation, discussion |
| Key words: | gas exchange system, lung, muscle |

This activity can help develop students’ understanding of the presence and roles of muscles in organs and organ systems. It can be used in response to the following diagnostic questions:

* Diagnostic question: Moving through the digestive system
* Diagnostic question: Breathing

**What does the research say?**

When children up to age 15 were asked to draw what is inside the human body, most drew organs but very few drew muscles, and when muscles were drawn they were commonly only depicted in the limbs (Reiss et al., 2002; Bartoszeck, Machado and Amann-Gainotti, 2011). Driver’s review of the research literature suggested that there was no evidence that school-age children recognise the involvement of muscles in the digestive, circulatory and respiratory systems (Driver et al., 1994).

Several studies have found that children from ages 4 to 10 do not appreciate that food is pushed through the digestive tract by waves of muscle contraction (peristalsis), believing instead that gravity and body movements such as walking and bending are responsible (Teixeira, 2000; AHİ, 2017).

**Ways to use this activity**

Students should complete this activity in pairs or small groups. The ‘apple in a sock’ model of food moving through the digestive system could be demonstrated to the class, or each group could be given their own apple and sock. The ‘balloon in a bell jar’ model of breathing should be set up at the front of the class and done as a demonstration.

The focus of the activity should be on group discussion to talk about the models and how to answer the questions. The models are presented in this activity, and should be presented to students, without any indication of whether they are good or bad models; students are challenged to share their thoughts through their small group discussions about what are the good or useful features of the models, and about what are the bad features or limitations.

It is through the discussions that students can check their understanding and develop their explanations. Listening in to the conversations of each group will often give you insights into how your students are thinking. The quality of the discussions can be improved with a careful selection of groups; or by allocating specific roles to students in the each group. For example, you may choose to select a student with strong prior knowledge as a scribe, and forbid them from contributing any of their own answers. They may question the others and only write down what they have been told. This strategy encourages contributions from more members of each group.

After their discussions, each group should be prepared to report the key points of their discussion to another group, or to the class.

**Equipment**

For each pair/group, or for demonstration to the class:

* a piece of fruit such as an apple or an orange
* a sock, preferably striped

For demonstration to the class:

* bell jar
* bung to fit bell jar, with hole for glass tube
* glass tube
* balloon
* rubber sheet
* elastic bands or similar, to attach rubber sheet to bell jar

The seals between the bung and the bell jar, between the bung and the glass tube, and between the bell jar and the rubber sheet (diaphragm) must be tight.

**Expected answers**

*The digestive system*

1. The apple represents food that has been eaten/swallowed.
2. The sock represents the digestive system / digestive tract / gut / oesophagus / stomach / intestines.
3. The stripes represent rings of muscle.
4. Fingers can be closed in a ring around the sock to represent the rings of muscle contracting. A wave of muscle contraction (peristalsis) pushes the food along.
5. The sock is only open at one end, so the food would not be able to get out. The sock is much shorter than the human digestive tract. The apple is not broken down/digested/absorbed as it moves along.

*The gas exchange system*

1. The balloon represents a lung, or one air sac/alveolus.
2. The bell jar represents the ribcage or the walls of the chest/body.
3. The sheet of rubber represents the diaphragm.
4. The rubber sheet can be pulled down to represent the diaphragm contracting. This increases the volume and decreases the pressure inside the bell jar (chest), which moves air into the balloon (lung).
5. The bell jar is rigid and does not move, unlike the ribcage. The intercostal muscles are not represented in the model, nor their role in expanding the rib cage when they contract during inhalation.

**Acknowledgments**

Developed by Alistair Moore (UYSEG), from an idea described by Fullick (2011).

Images: UYSEG

**References**

AHİ, B. (2017). Thinking about digestive system in early childhood: a comparative study about biological knowledge. *Cogent Education,* 4(1).

Bartoszeck, A. B., Machado, D. Z. and Amann-Gainotti, M. (2011). Graphic representation of organs and organ systems: psychological view and developmental patterns. *EURASIA Journal of Mathematics, Science & Technology Education,* 7(1)**,** 41-51.

Driver, R., et al. (1994). *Making Sense of Secondary Science: Research into Children's Ideas,* London, UK: Routledge.

Fullick, A. (2011). Gas exchange, movement and fitness. In Reiss, M. (ed.) *ASE Science Practice: Teaching Secondary Biology.* 2nd ed. London, UK: Hodder Education.

Reiss, M. J., et al. (2002). An international study of young peoples' drawings of what is inside themselves. *Journal of Biological Education,* 36(2)**,** 58-64.

Teixeira, F. M. (2000). What happens to the food we eat? Children's conceptions of the structure and function of the digestive system. *International Journal of Science Education,* 22(5)**,** 507-520.