**Muscle fuel**



Your teacher is going to add a few drops of ‘muscle fuel’ to a piece of fresh muscle.

The ‘muscle fuel’ contains everything a muscle needs to work.

**Predict**

What will happen to the piece of muscle when the ‘muscle fuel’ is added?

**Explain**

Explain why you think this will happen.

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| Your teacher will now add a few drops of ‘muscle fuel’ to the piece of muscle. |

**Observe**

Watch what happens to the piece of muscle.

**Explain**

Was your prediction correct?

If not, how would you explain what you observed?

*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** |
| **Muscle fuel** |

**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: | Recognise that muscles, including antagonistic muscles, move bones by contracting. |
| Activity type: | Practical PEOE |
| Key words: | muscle, tissue |

This activity can help develop students’ understanding of how muscles move bones by contracting, and specifically the idea that muscles can only pull. It can be used in response to the following diagnostic questions:

* Diagnostic question: Biceps and triceps

**What does the research say?**

Several studies have found that children up to age 20 struggle to appreciate that individual bones are not isolated but are connected to make a functional skeleton (Guichard, 1995; Tunnicliffe and Reiss, 1999). While young children only recognise the supportive and protective (static) functions of the skeleton, older children understand that the skeleton is necessary for movement; however, only one fifth of the older children in one study could draw muscles correctly across a joint (Caravita et al., 1988).

Use of real muscles and bones can help children to understand this more effectively, including the idea that muscles can only pull (Haddad, 1995; Goodwyn and Salm, 2007; Fullick, 2011).

**Ways to use this activity**

This activity takes the form of a predict-explain-observe-explain (PEOE) activity, which allows students to apply what they know to make predictions, and to build explanations for what they have predicted and what they observe.

Begin by showing the class a strip of muscle fibre on a microscope slide or white tile, which has been cut from a piece of fresh meat such as beef or pork (be aware of religious sensitivities). Use of a visualiser may be helpful, so that all of the class can watch together. Tell the students that you will add a few drops of ‘muscle fuel’ to the strip (but don’t add them just yet). The ‘muscle fuel’ is a solution of ATP (which will trigger muscle contraction) but describing it as ‘muscle fuel’ and saying that it contains everything a muscle needs to work (**don’t** say ”contract”) will be more helpful for students at age 11-14.

Students should then be allowed time to work in pairs or small groups to discuss *what* they think will happen (prediction), and then to explain *why* they think it will happen (explanation). It is through the discussions that students can check and develop their understanding. If students in any group cannot agree, you may be able to direct them with some careful questioning.

You should now add a few drops of ATP solution to the strip of muscle, which should cause it to contract.

After the practical each group should be given the opportunity to change, or improve their explanation in light of their observations. A good way to review your students’ thinking might be through a structured class discussion. You could ask several groups for their explanations and put these on the whiteboard. Then ask other groups to suggest which explanation is the best and why, the through careful questioning work up a clear ‘class explanation’.

A useful follow up is for individual students to then write down explanations in their own words – without reference to the class explanation on the board (i.e. cover it up).

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.

**Equipment**

For demonstration to the class:

* one strip of muscle tissue, 1 mm wide and 20-30 mm long, cut from fresh beef or pork
* forceps
* microscope slide or white tile
* ATP solution in a 1 cm3 syringe (at the concentration provided by the supplier)
* kitchen towel
* disinfectant
* visualiser (optional)

The meat needs to be very fresh and should be cut along the length of the muscle (parallel to the fibres). Be aware of religious sensitivities when using meat.

Wipe surfaces with disinfectant afterwards.

**Expected answers**

Students should predict that the piece of muscle will get shorter, because the ‘muscle fuel’ makes it contract. They may also suggest that it will relax and get longer again (return to its original length) when the fuel has been used up.

**Acknowledgments**

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Images: adapted by UYSEG from pixabay.com/LillyCantabile (3314164)

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