Chicken Wing Dissection **Method**

Equipment

chicken wing

dissection scissors

dissection board or tray

disinfectant

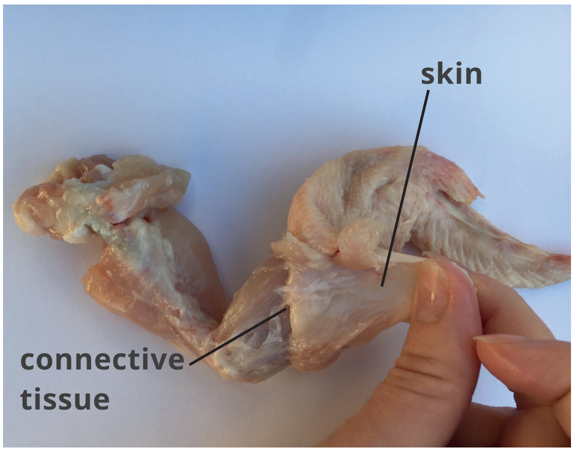
antibacterial handwash

Risk Assessment

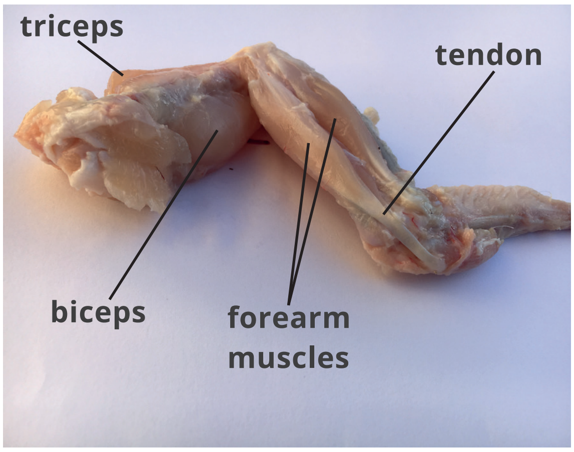
Hazard	Harm It Can Do	How You Will Minimise the Risk
disinfectant	Can be hazardous if ingested. May cause irritation.	Do not taste. Avoid contact with skin. Wear goggles.
dissection tools	The sharp edges and points can pierce or cut the skin.	Cut away from your body and other people. Ensure the floor is clear of obstacles. Carry the tools around the room in a tray. If cuts occur, apply pressure to the wound and inform teacher.
raw chicken	Uncooked chicken may contain *Salmonella* bacteria which can cause food poisoning.	Do not taste or eat any of the chicken. Do not touch your face, other people or other equipment during the dissection. Once the dissection is finished, wash your hands with antibacterial handwash.

Method

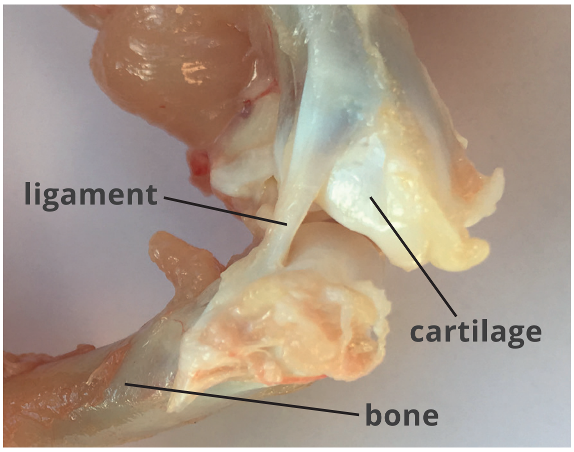
1. Carefully peel back the skin from the shoulder down to the wing tip. Use the scissors to cut any connective tissue that is holding the skin to the muscle. Take care not to cut any of the muscle.



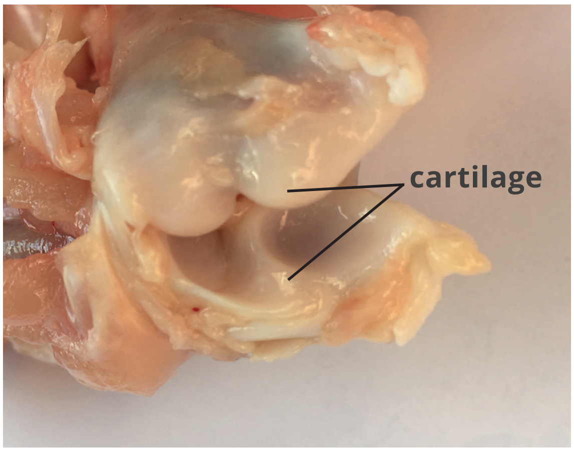
2. Identify the four main muscles of the wings. This is the pink, pale tissue.
3. Identify the tendons. This is the tough, white tissue that connects the muscle to the bone.
4. Hold each end of the wing and gently pull them away from each other. Observe what happens to the muscles.



5. Gently straighten the wing then hold only the shoulder end of the wing. Pull on the bicep and observe what happens.
6. Gently pull on the forearm muscles, one at a time. See if you can you make the wing wave hello.
7. Cut the tendons around the elbow and pull away the muscles.



8. Pull gently on the two bones to open up the joint. Identify the tough, white ligaments that connect the two bones across the joint.
9. Cut the ligaments and observe the ends of the bones. Identify the type of joint.
10. Scrape the surface of the cartilage at the end of the bone and a spot in the middle of the bone. Compare the surface of each part of the bone.



11. Clear away by scraping all of the chicken bits into the bin. Ensure that all tools go into the disinfectant.
12. Without touching the tap with your hands, wash your hands thoroughly including under the nails.

Chicken Wing Dissection Observations **Answers**

Students' descriptions may vary but might include some of the observations below.

Tissue	**Appearance** (What does it look like?)	**Texture** (What does it feel like?)	**Function** (What is its job?)
skin	**pale, pinkish colour**	**bumpy**	**to protect the body from the outside environment**
muscle	**pink, rounded**	**smooth** **can be squashed**	**to contract to bring about movement**
tendon	**white, long and narrow strip**	**strong, smooth**	**to connect a muscle to the bone**
ligament	**white, long and narrow strip**	**strong, smooth**	**to connect one bone to another across a joint**
cartilage	**bright white, shiny**	**very smooth and slippery** **can be scratched**	**to allow the bones to move across each other at a joint without rubbing against each other** **reduces friction at the joint**
bone	**dull white/grey**	**hard** **difficult to scratch**	**to support the body and help it to move** **produces blood cells**

Chicken Wing Dissection **Observations**

Follow the method to carry out the chicken wing dissection and record your observations in the table below.

Tissue	**Appearance** (What does it look like?)	**Texture** (What does it feel like?)	**Function** (What is its job?)
skin			
muscle			
tendon			
ligament			
cartilage			
bone			

Chicken Wing Dissection
Teacher and Technician Notes

Safety Information

It is the responsibility of the teacher to carry out an appropriate risk assessment.

Teachers should determine whether there are any students with known allergies to chicken or disinfectants in advance of the lesson.

Students should be shown how to safely handle dissection tools before they begin the investigation. Instruments with sharp points should be used so that the edges point into the dissection tray/board and away from the body.

Chicken wings should be obtained from premises licensed to sell them for human consumption. This means that the source will have been inspected to ensure that only the products of healthy animals will be used.

The chicken wings should be stored in a fridge at 5°C or below until just before use. Frozen wings should be thoroughly defrosted in a fridge before use.

The dissection should be carried out before the use-by date on the packaging.

The cutting edges of dissection tools should be checked before used. Blunt edges are more likely to cause injury and should be replaced.

Eye protection should be worn to protect the eyes from bone fragments if students snap the bones.

Consider modelling proper handwashing technique to students. They will need to be able to wash their hands without touching the tap.

Benches and taps should be disinfected after the dissection and before they are used by others.

Notes

Students should be informed about the dissection prior to the lesson and should be given the opportunity to opt out of this dissection. Some students may wish to work in a different classroom while the dissection is being carried out.

Wooden chopping boards are difficult to disinfect. Consider using plastic trays or boards instead.

Lab coats or protective aprons can be used to prevent clothing from becoming contaminated.

Dissection tools can be sterilised in an autoclave or pressure cooker, or by soaking in 70% ethanol for 10 minutes.

Equipment Per Group

1 chicken wing

1 dissection board or tray

1 pair of dissection scissors

access to a bucket of disinfectant to place tools after use

access to antibacterial handwash

Resources

The **Chicken Wing Dissection PowerPoint** includes step-by-step instructions for carrying out the dissection. The practical works best if you display one slide at a time and allow students to carry out those steps before moving on, rather than working through all of the slides before they begin. Photographs are included on the slides to help students identify the correct tissues on their chicken wing. Encourage students to move slowly through the practical so that they do not accidently cut the incorrect tissues. It may be useful to have some spare wings available in case this happens.

The **Chicken Wing Observation Sheet** provides space for students to record their observations about appearance and texture of each part. To avoid transfer of fluid from the chicken to students' work, students should not complete the sheet while carrying out the dissection. One student could be responsible for completing the sheet away from the dissection area, as long as they do not touch the chicken or equipment. Alternatively, students could complete the worksheet after the dissection has been cleared away and they have washed their hands.

Once the skin has been removed from the chicken wings, allow the students to take time to manipulate the muscles. When holding the top of the bone (where the shoulder would be), they should be able to raise the wing by pulling on the biceps muscle and lower it by pulling on the triceps muscle. Alternating pulling on the muscles in the forearm will allow them to wave the tip of the wing. This is a great way for students to develop an understanding of how antagonistic muscles work together. A slide in the PowerPoint provides an explanation of this if required. If you have a visualiser, this could be used to model the movement to the whole class, or the **Chicken Wing Video** could be played to show the process.

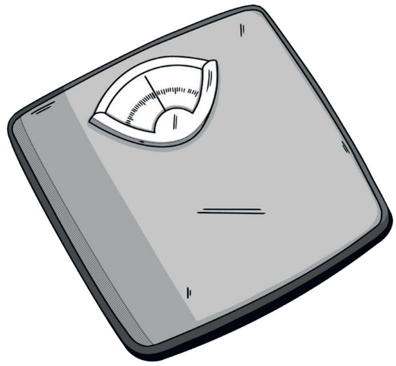
Disclaimer

We hope that you find the information on our website and in our resources useful. As far as possible, the contents of this resource are reflective of current professional research. However, please be aware that information can quickly become out of date. The information given here is intended for general guidance purposes only and may have to be adapted to meet the needs of your students.

The activities set out in this resource are potentially hazardous. The activities are not suitable for all children and adult supervision may be required for some of the activities. It is your responsibility to assess whether the children in your care are able to safely carry out the activities and whether the children require adult supervision. You are responsible for carrying out proper risk assessments on the activities and for ensuring that activities can be carried out safely. We are not responsible for the health and safety of your group or environment so, insofar as it is possible under the law, we cannot accept liability for any loss suffered by anyone undertaking the activity or activities referred to or described in this resource. It is also your responsibility to ensure that those participating in the activity are fit enough to do so and that you or the organisation you are organising for has the relevant insurance to carry out the physical activity. If you are unsure in any way, we recommend that you take guidance from a suitably qualified professional.

Measuring Force with Scales

Scales are calibrated to display the mass of an object on Earth, in kilograms. The mass is the amount of matter that makes up the object.



When a mass is in a gravitational field, it experiences a force. The strength of this force depends on the gravitational field strength.

The force exerted on an object due to gravity is known as weight. Weight is measured in newtons (N).

The weight of an object can be calculated using the following equation:

weight = mass × gravitational field strength

Earth has a gravitational field strength of 10N/kg. This means that an object with a mass of 1kg would be attracted towards the centre of Earth with a force of 10N.

When you push down on a set of scales, you exert force on the scales. However, the scales are calibrated to reduce this measurement by a factor of 10 so that mass in kilograms is displayed.

To calculate the force in newtons, you will therefore multiply the reading by 10.

For example:

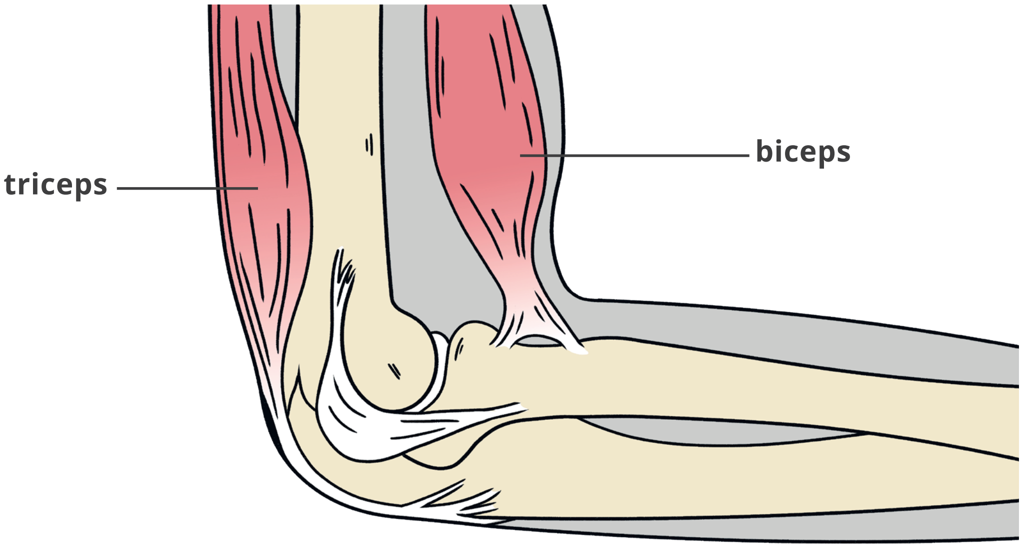
You push down on the scales and get a reading of 16kg.

force exerted = 16kg × 10N/kg

force exerted = 160N

Measuring the Force Exerted by Muscles

The diagram shows the location of the muscles that you will use during this investigation.



You can use a scale to measure the force exerted by different muscles.

To measure the force exerted by the triceps, place the scales onto a bench and press down as hard as you can through the heel of the hand.

To measure the force exerted by the biceps, place the scales underneath the bench and push up as hard as you can through the heel of the hand.

If you are using scales that measure in newtons, you will be able to record the force exerted in newtons by reading from the scale.

If you are using scales that measure in kilograms, you will need to convert the measurement in kilograms to newtons. You can do this by multiplying the measurement in kilograms by 10.

Measuring the Force Exerted by Muscles **Answers**

1. Record the force exerted by each type of muscle. Remember to include the correct units.

   triceps **students' answers will vary**

   biceps **students' answers will vary**

2. State which muscle exerted the greatest force.

   Answer should be correct for the measurements recorded in Q1.

3. Complete the table with the measurements from three other people.

   Students' answers will vary, but some example answers are included below:

Muscle	Force Exerted by the Muscle (N)		
	Person 1	**Person 2**	**Person 3**
triceps	**147**	**282**	**105**
biceps	**143**	**262**	**89**

4. Describe how the force exerted varies between the different muscles and between people.

   Students' answers may vary depending on their measurements.

   For the model results above:

   Using this method, the triceps exerts a larger force than the biceps for each of the people tested. The force exerted by the muscles can vary significantly between individuals. For example, the triceps of person 2 exert a force of 282N while the triceps of person 3 only exert a force of 105N.

5. Suggest how you could measure the force exerted by a different muscle in your body.

   Students' suggestions will vary but may include putting force on scales with different muscles, such as leg muscles, or using a handgrip dynamometer.

Measuring the Force Exerted by Muscles

1. Record the force exerted by each type of muscle. Remember to include the correct units.

   triceps ______________________________

   biceps ______________________________

2. State which muscle exerted the greatest force.

   ____

3. Complete the table with the measurements from three other people.

Muscle	**Force Exerted by the Muscle (N)**		
	Person 1	**Person 2**	**Person 3**
triceps			
biceps			

4. Describe how the force exerted varies between the different muscles and between people.

   ____

   ____

   ____

   ____

5. Suggest how you could measure the force exerted by a different muscle in your body.

   ____

   ____

   ____

   ____

Antagonistic Muscle Model

Follow the instructions to create a working model of the arm. Your model will work best if your template is printed or stuck onto thin card.

1. Cut out the templates along the dotted lines.
2. Place the forearm over the upper arm so that the two black spots line up. Connect the pieces by pushing a split pin through the black spot.
3. Carefully make two holes through the grey spots.
4. Thread a piece of string up through the top hole so that it lies over the biceps muscle and attach it to the end of the radius with sticky tape.
5. Thread a second piece of string up through the bottom hole so that it lies over the triceps muscle and attach it to the end of the ulna with sticky tape.
6. Add glue only to underside of the upper arm bone (humerus) and stick it into your book.
7. Pull on each string and observe what happens to the forearm.

You will need:

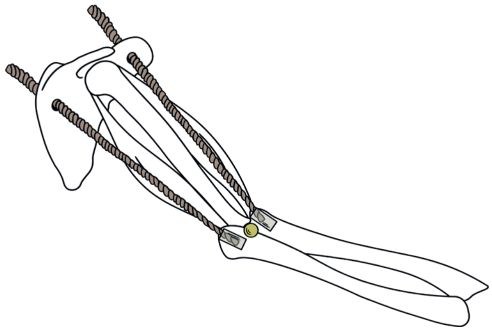
Muscle Model Template

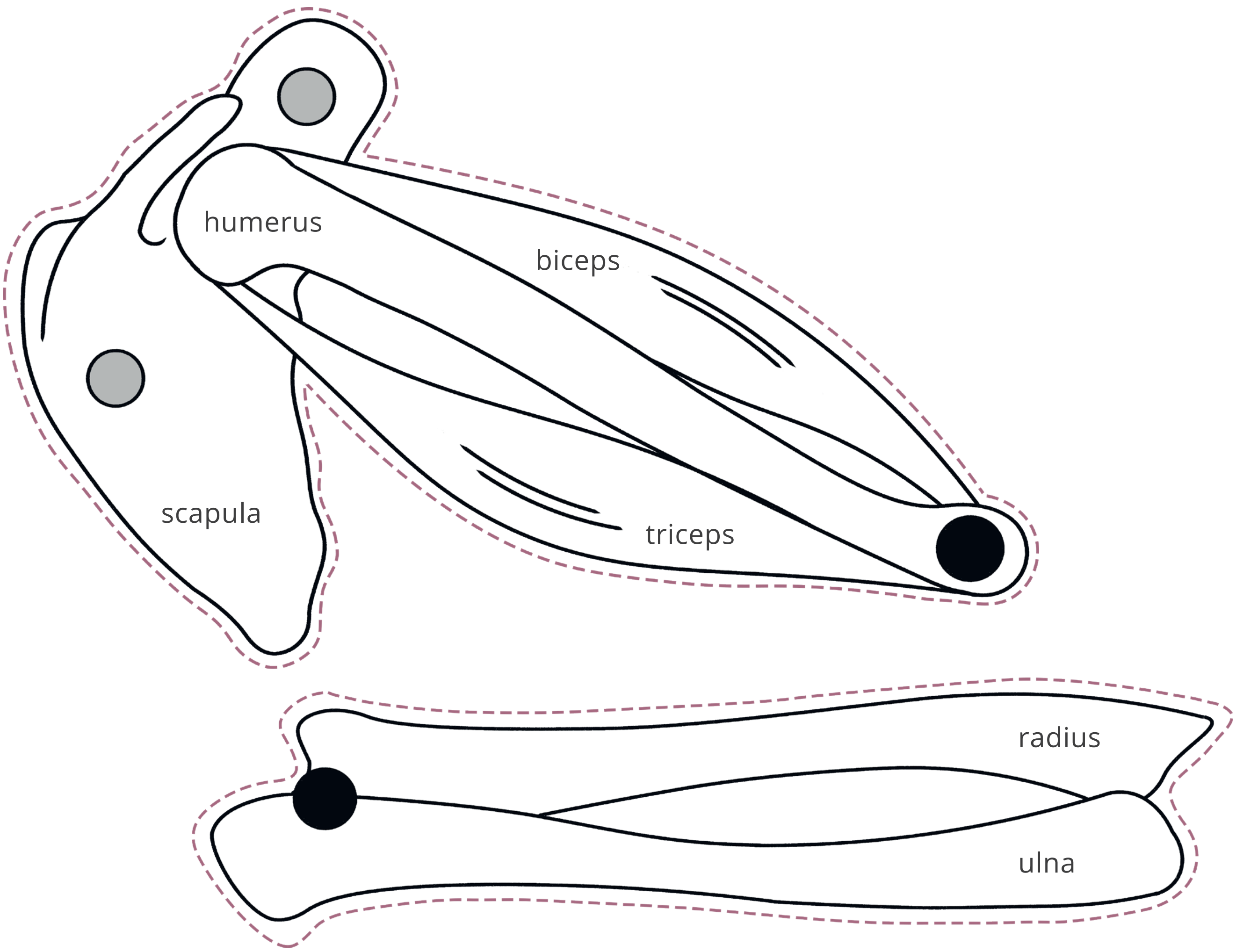
a split pin

two pieces of string

scissors

sticky tape





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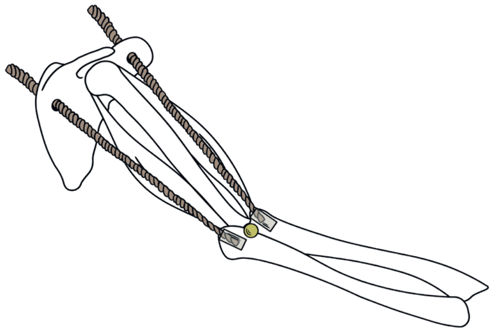

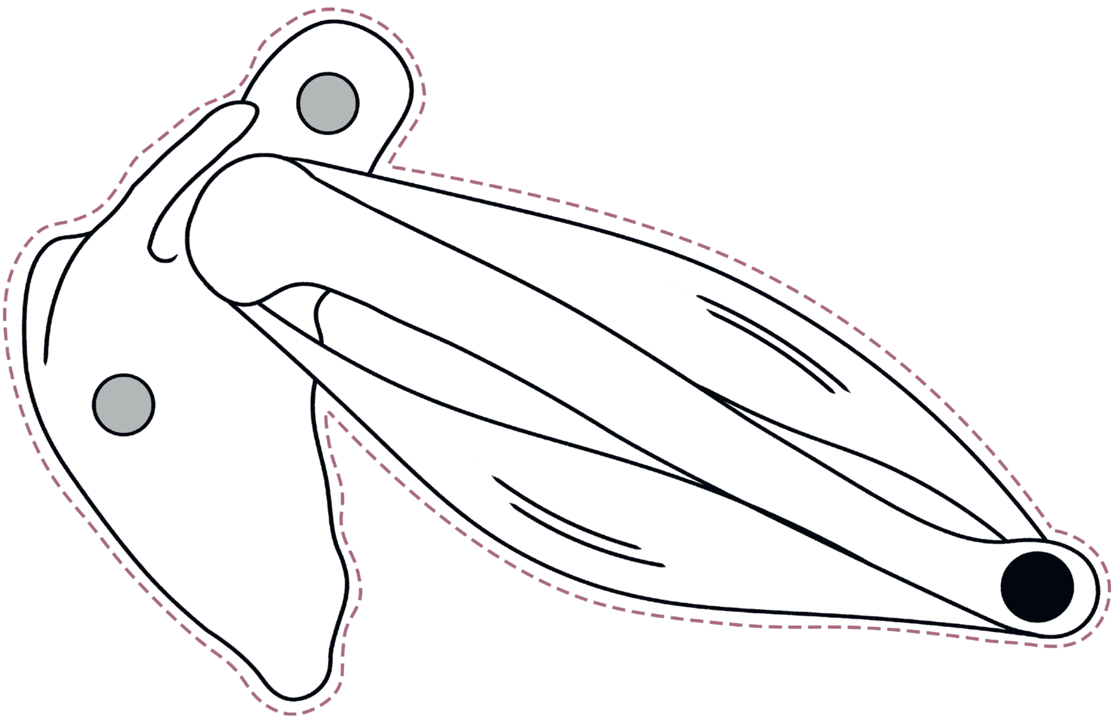

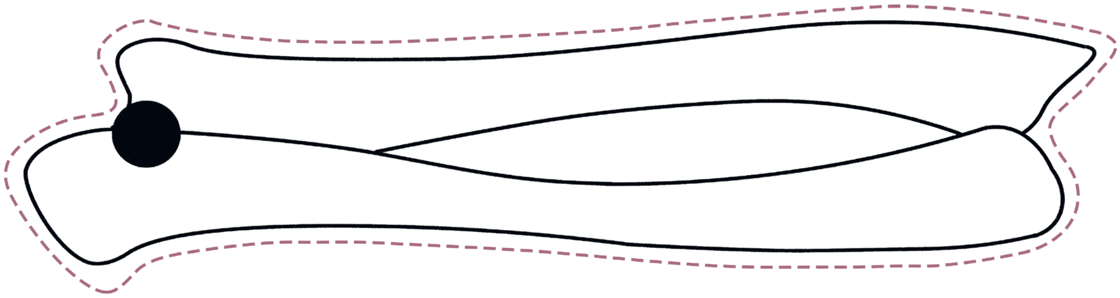

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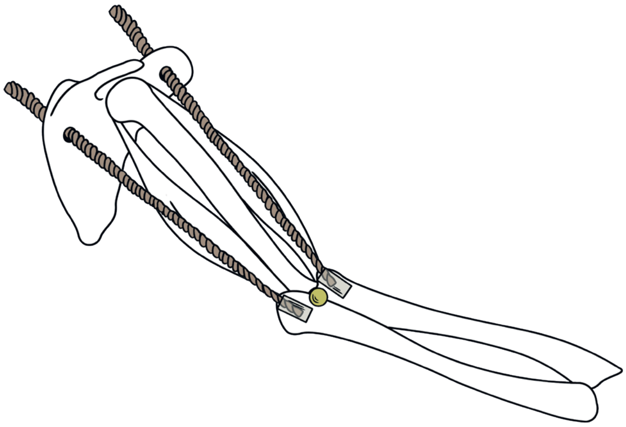

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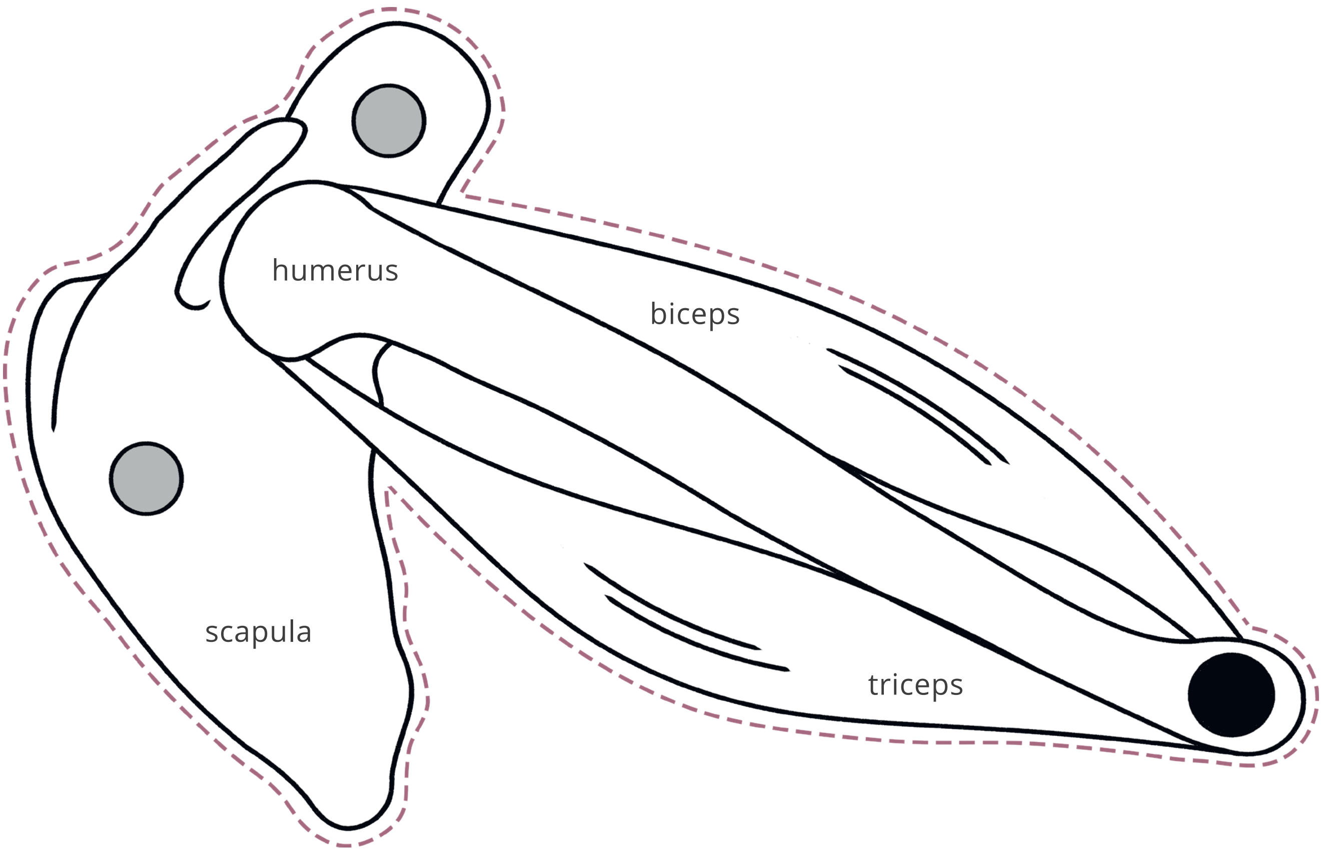
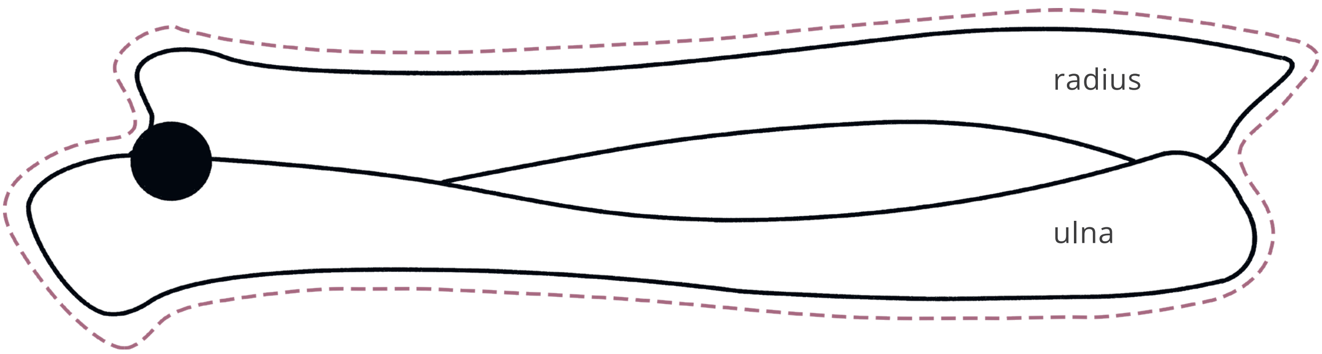
Antagonistic Muscle Model Template

Upper Arm



Forearm



Antagonistic Muscle Model Template

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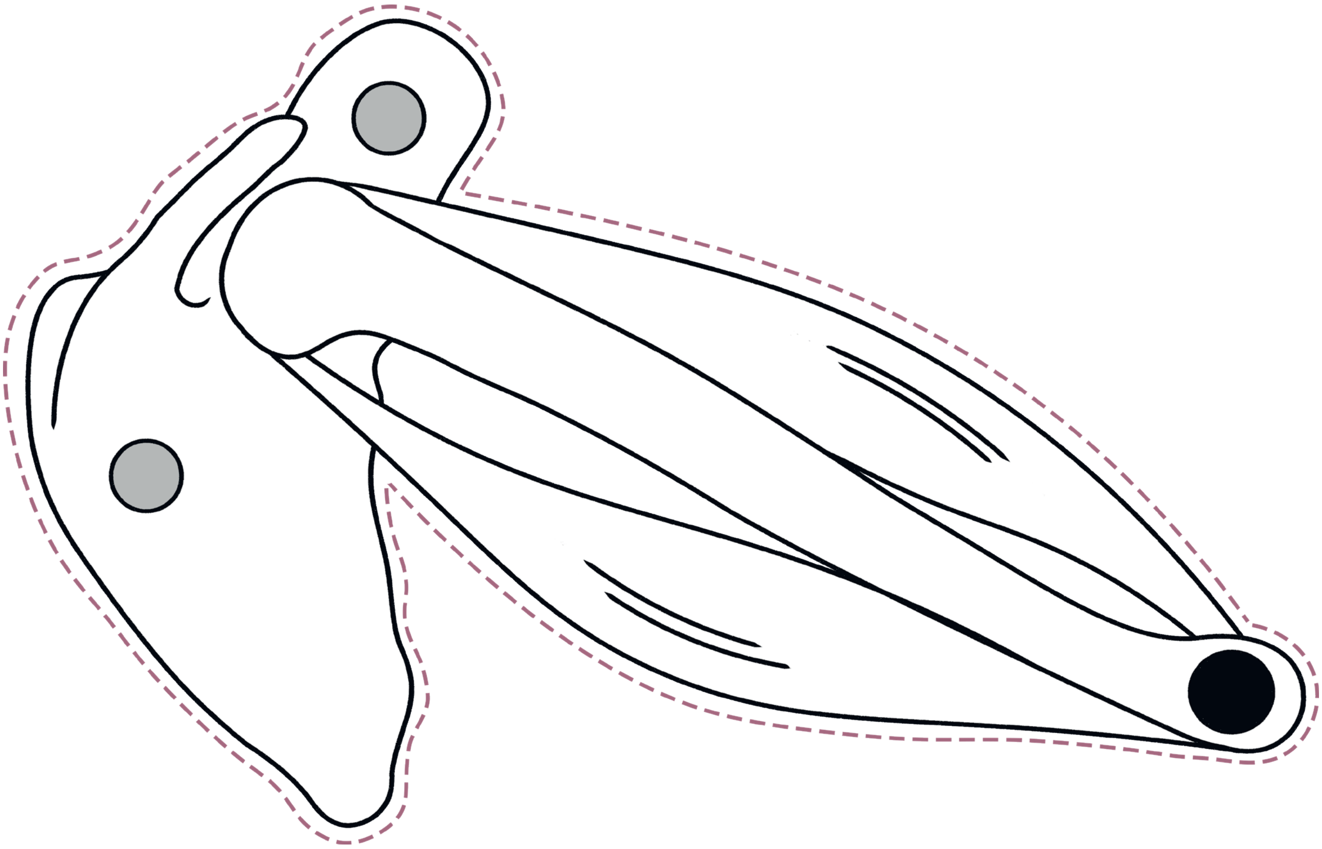
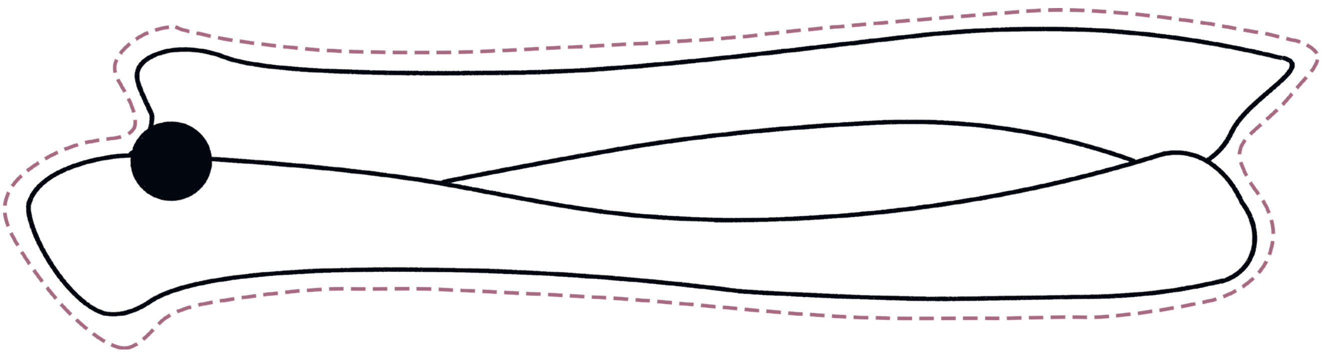


Forearm



Evaluating Muscle Models **Answers**

Students' evaluations may vary but may include some of the points below.

Paper or Cardboard Model

Strengths

- **When the string is pulled, the length of string between the bones shortens. A contracting muscle also shortens.**
- **The movement caused by pulling each string matches the movement caused by contracting each muscle in the arm.**

Weaknesses

- **The shoulder joint is fixed but this would be able to move in a real arm.**
- **There are no tendons in the model.**
- **The string doesn't stretch or contract like a real muscle.**
- **The strings are pulled one at a time to model the movement. In the real arm, both muscles are involved in each movement.**

Chicken Wing

Strengths

- **The wing has a similar body plan to the human arm.**
- **The model includes real muscles, bones and tendons.**
- **The model shows the movement at both the elbow and wrist joints.**

Weaknesses

- **The muscles are pulled rather than contracting.**
- **The wing is smaller than the human arm and is the only model that couldn't be made the correct size.**

Balloon Model 1

Strengths

- **The shapes of the balloons change like real muscles do.**
- **The ends of the balloons act like tendons, attaching the muscles to the bones.**

Weaknesses

- **Contraction of the muscles is modelled by moving the arm. In a real arm, it is the contraction that causes the arm movement.**
- **The balloon used to represent the triceps muscle isn't as effective at showing the contraction as the balloon used to represent the biceps muscle.**
- **Only one lower arm bone is represented in the model.**

Balloon Model 2

Strengths

- **The expanding balloon models what happens to the muscle if you contract your arm.**
- **The movement caused by blowing into each balloon matches the movement caused by contracting each muscle in the arm.**
- **The tendons are represented in the model.**

Weaknesses

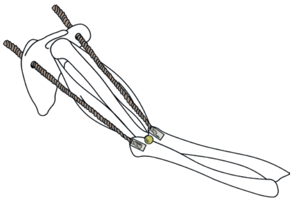
- **You have to blow into the balloon to model the muscle movement.**
- **The muscles are within a cage which the tendons are attached to which does not reflect real arm muscles.**
- **The muscles are attached to the lower arm bones by tendons but they are fixed directly to the upper arm bones.**
- **It suggests that the muscles expand instead of contracting.**

Evaluating Muscle Models

Scientific models can help us to visualise things that we cannot see for ourselves. However, they are not usually a perfect representation of the real thing.

Evaluate the four models to decide how well they each represent a real human arm.

Paper or Cardboard Model



Describe the strengths of the model.

Describe the weaknesses of the model.

Chicken Wing

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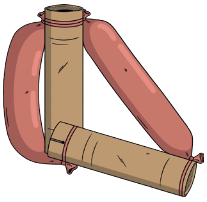
Balloon Model



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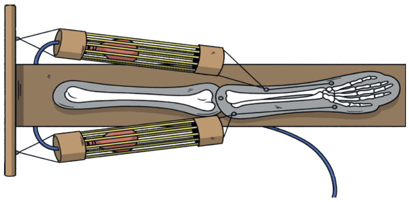
Balloon Model 2



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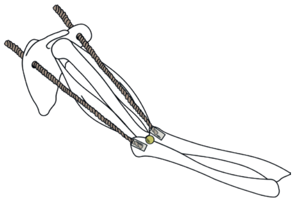

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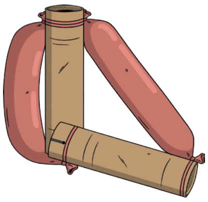

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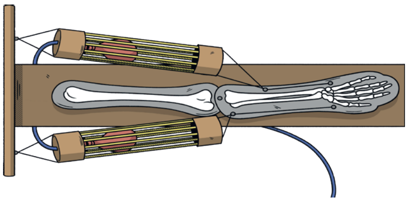

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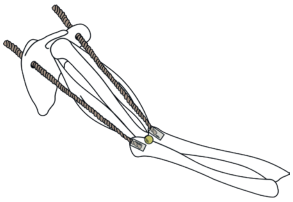

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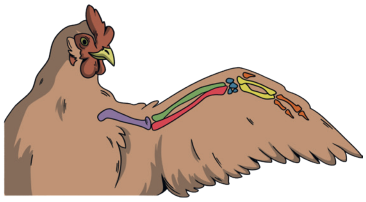

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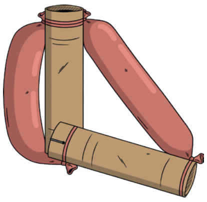

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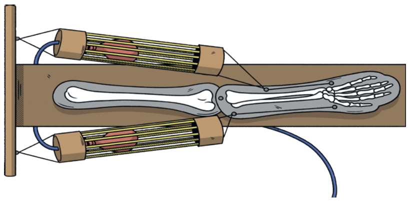

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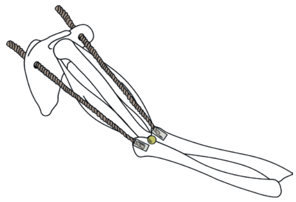

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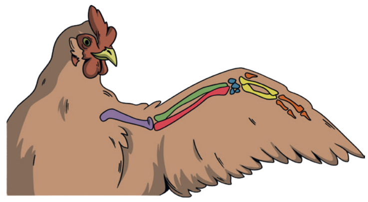
Chicken Wing



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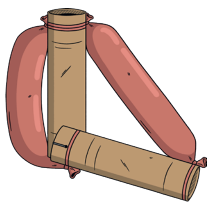

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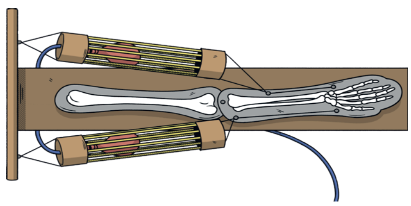
Balloon Model 2



Describe the strengths of the model.

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Describe the weaknesses of the model.

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Modelling Antagonistic Muscles
Teacher Notes

The pack includes information about four different ways of modelling the biceps and triceps muscles. Students could use the information on the **Muscle Model Information Sheets** to complete the **Evaluating Muscle Models worksheet**, which asks them to summarise the strengths and weaknesses of each model. Two versions of the **Muscle Model Information Sheets** are provided. One version includes a photograph of a raw chicken wing, while the second version has the photograph omitted. The second version should be provided for students who do not wish to view the chicken wing.

It is not necessary to provide the models, although students will find it easier to evaluate them if they are able to manipulate them themselves. You could set up a circuit in the classroom so that students can visit each model and explore the strengths and weaknesses.

Alternatively, you could explore each of the models in the ways suggested below.

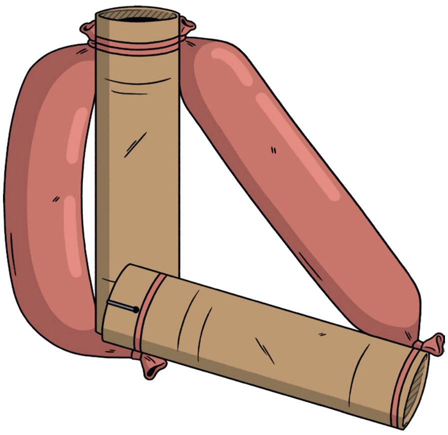
The first model is a paper or card model. An **Antagonistic Muscle Paper Model Template and Instructions** are provided so that students can build this model and stick it into their books.

The second model is a chicken wing. Students could complete a chicken wing dissection to manipulate the muscles themselves, or you could show the movement of one wing as a demonstration.

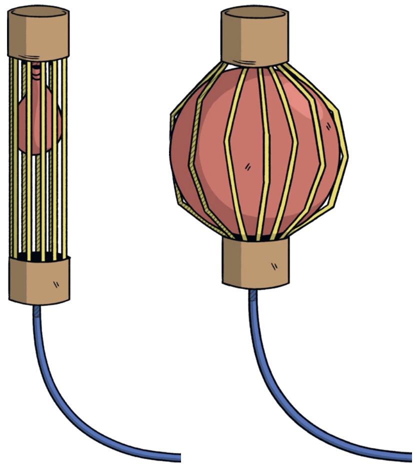
The final two models both use balloons in different ways to model the movement of the muscles. You could build these in advance of the lesson to demonstrate to students.

Preparing Balloon Model 1

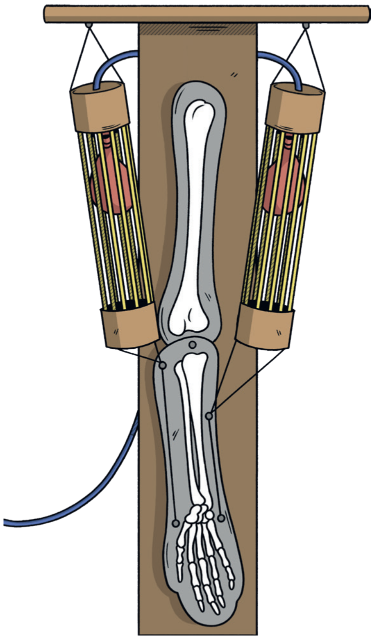
1. Poke holes through one end of each cardboard tube.
2. Join the two tubes together by passing a straightened paperclip or wire through the holes and securing at each end.
3. Partially inflate two long balloons, so that there is a length of uninflated balloon remaining at each end.
4. Tie one end of each balloon to either side of the upper arm bone.
5. Tie the opposite end of one balloon to the lower arm bone near to the joint.
6. Tie the opposite end of the other balloon to the far end of the lower arm bone.



Preparing Balloon Model 2



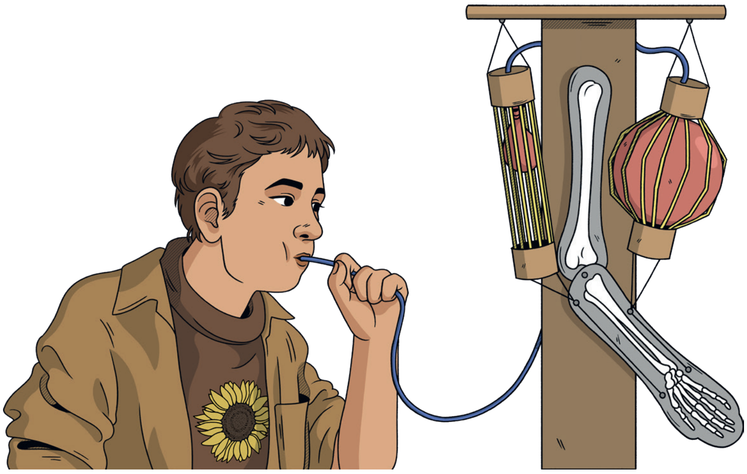
1. Make two cardboard rings or cut two rings from a toilet roll tube.
2. Attach straws to the rings to make a cage as shown.
3. Add a tube to the mouth of a balloon and put the balloon into the cage.



4. Cut out two pieces of cardboard to represent the upper and lower arm bones and attach at the joint using a split pin or wire so that they can pivot.
5. Attach a cage to each side of the upper arm bone, by stapling or clipping the top cardboard ring to the top end of the bone.
6. Use string to attach the bottom of the cage to the radius and ulna as shown.

You could attach the model to a stand or have someone hold the top of the model.

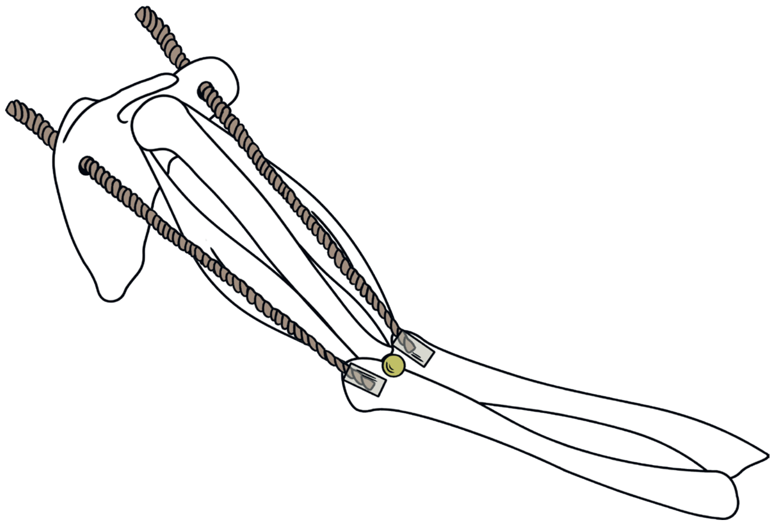
Check that when you blow into the tube, the balloon inflates and moves the lower arm bones.



Modelling Antagonistic Muscles

Paper or Cardboard Model

Pieces of paper or card are used to represent the upper arm and the forearm. The two parts of the arm are attached at the elbow with a split pin so that they can move past each other. The upper arm is stuck down and string is threaded through the upper arm and attached to each bone in the forearm.

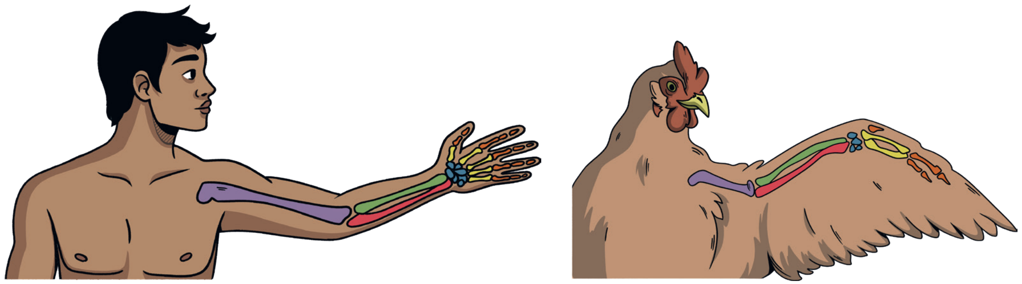


Pulling on the top string causes the forearm to lift up. This models the arm movement that occurs when the biceps muscle contracts.

Pulling on the bottom string causes the forearm to move down. This models the arm movement that occurs when the triceps muscle contracts.

Chicken Wing Model

The bones in the human arm have a similar structure to the bones in the wing of a bird. The bones, muscles and other tissues that cause the wings of a chicken to move work in the same way as the bones, muscles and tissues in human arms.



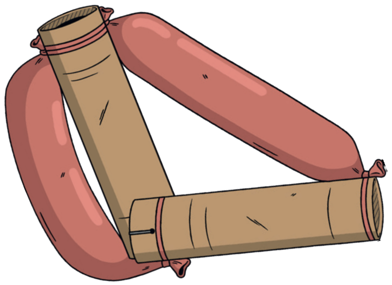
By using animal models, researchers can carry out experiments that they would not be able to do with humans.

The skin is removed from the chicken wing to expose the muscles.

Pulling on the biceps muscle causes the forearm to move in one direction. Pulling on the triceps muscle causes the forearm to move in the other direction. The muscles in the forearm can also be pulled on to move the tip of the wing up and down.

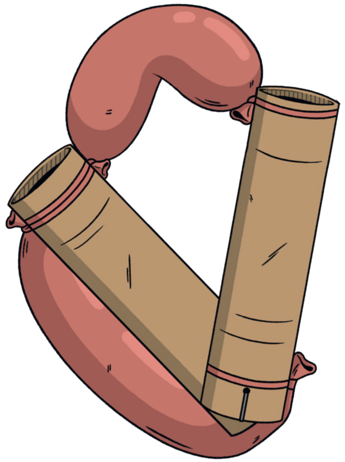
Balloon Model 1

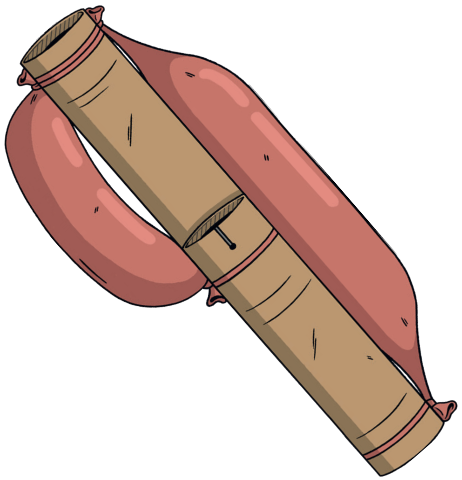
Cardboard tubes are used to represent the arm bones. The tubes are attached together so they can pivot. One balloon is tied to the front of the humerus and the top of the forearm to represent the biceps muscle. Another balloon is tied to the back of the humerus and the bottom of the forearm to represents the triceps muscle.



When the forearm is moved up, the biceps balloon gets squashed. This models a contracted biceps muscle.

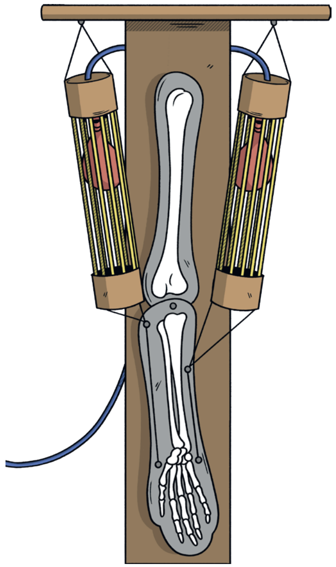
When the forearm is moved down, the bicep stretches again. The triceps balloon becomes a little smaller, representing a contracted triceps muscle.

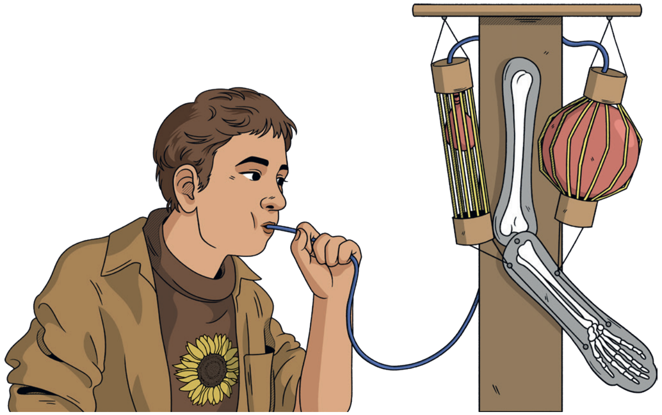




Balloon Model 2

Balloons are inserted into a tube made from straws that bend. A tube is attached to the balloon so that it can be blown up. These structures represent the muscles. The tubes are attached to the bones by strings that represent the tendons.



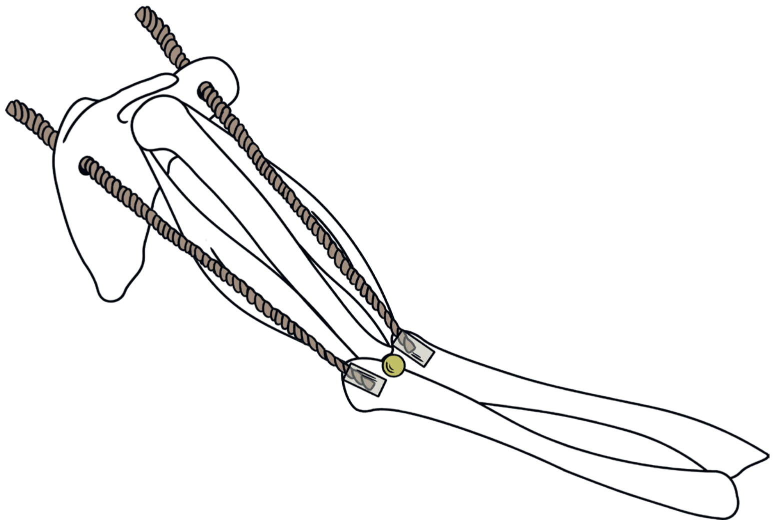


When the biceps balloon is blown up, the straws bend outwards and pull the end caps towards each other. This pulls on the strings (tendons) and lifts the arm. When the triceps balloon is blown up the arm moves in the opposite direction. The inflation of the balloon represents muscle contraction.

Modelling Antagonistic Muscles

Paper or Cardboard Model

Pieces of paper or card are used to represent the upper arm and the forearm. The two parts of the arm are attached at the elbow with a split pin so that they can move past each other. The upper arm is stuck down and string is threaded through the upper arm and attached to each bone in the forearm.



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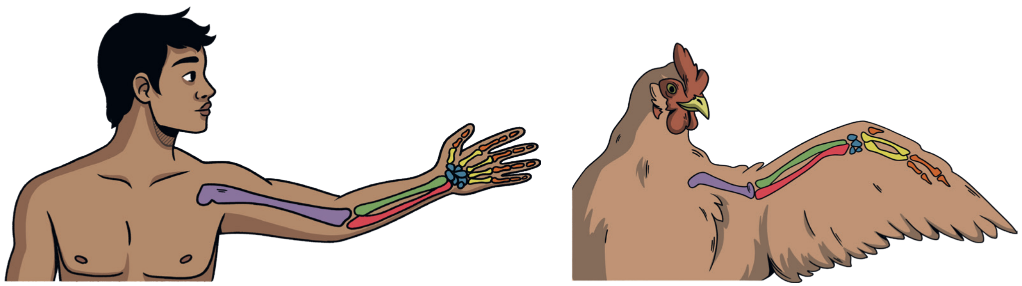

By using animal models, researchers can carry out experiments that they would not be able to do with humans.

A chicken wing bought from a butcher or supermarket can be used as a model to study how muscles work. The skin is removed from the chicken wing to expose the muscles. Pulling on the biceps muscle causes the forearm to move in one direction. Pulling on the triceps muscle causes the forearm to move in the other direction. The muscles in the forearm can also be pulled on to move the tip of the wing up and down.

Balloon Model 1

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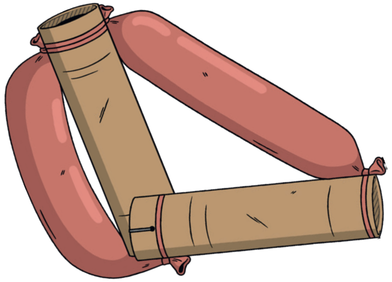
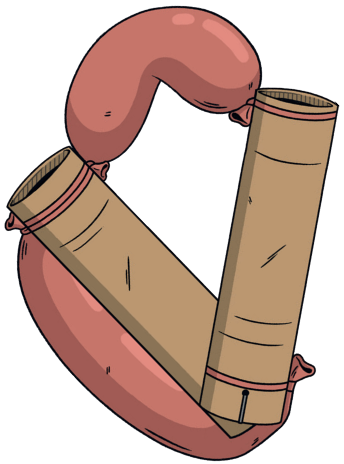
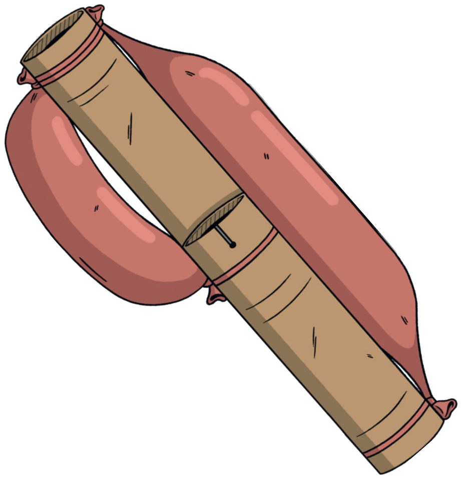


When the forearm is moved up, the biceps balloon gets squashed. This models a contracted biceps muscle.

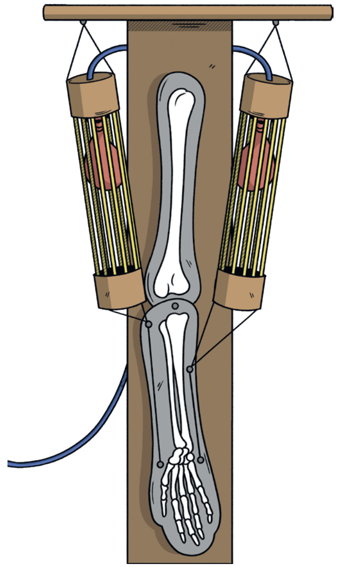
When the forearm is moved down, the bicep stretches again. The triceps balloon becomes a little smaller, representing a contracted triceps muscle.

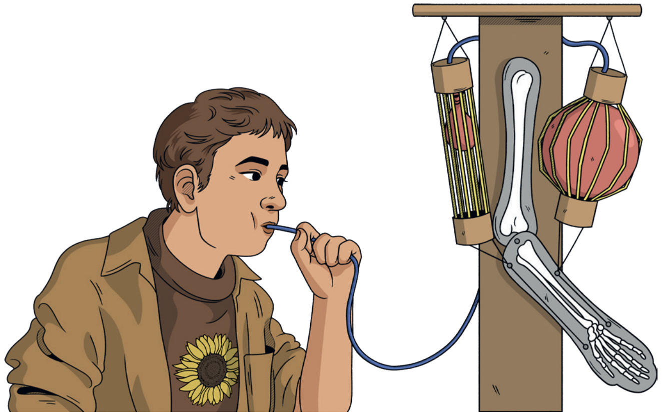




Balloon Model 2

Balloons are inserted into a tube made from straws that bend. A tube is attached to the balloon so that it can be blown up. These structures represent the muscles. The tubes are attached to the bones by strings that represent the tendons.





When the biceps balloon is blown up, the straws bend outwards and pull the end caps towards each other. This pulls on the strings (tendons) and lifts the arm. When the triceps balloon is blown up the arm moves in the opposite direction. The inflation of the balloon represents muscle contraction.

Cells and Organisation
Muscles

Learning Objective

To understand how muscles interact with different tissues in the body to cause movement.

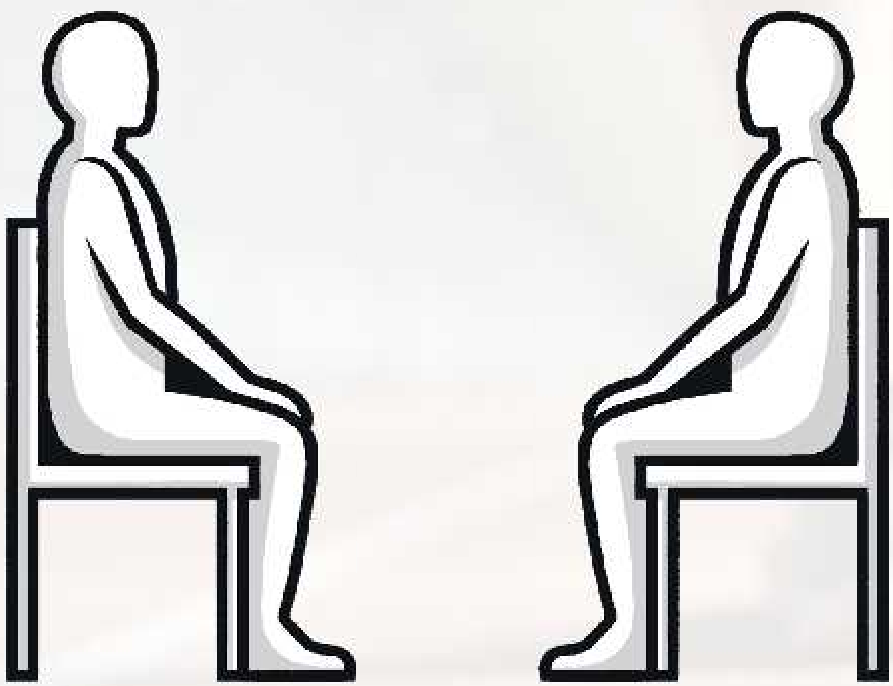
Success Criteria

- To identify the different tissues that connect bones and muscles.
- To explain why some organs contain muscle tissue.
- To discover how an antagonistic pair of muscles work together.

Don’t Move a Muscle

Think about all of the muscles in your body. Where are they found?

Sit facing your partner.
You will both try and keep perfectly still for 30 seconds.
Watch your partner closely so that you can see if they move.



Don’t Move a Muscle

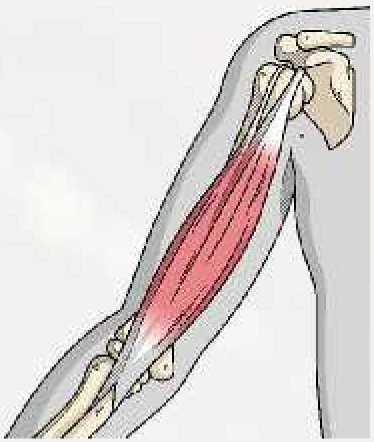
Raise your hand if you think you managed to stay completely still for the whole 30 seconds.

Put your hand down if you blinked.

Put your hand down if you took a breath.

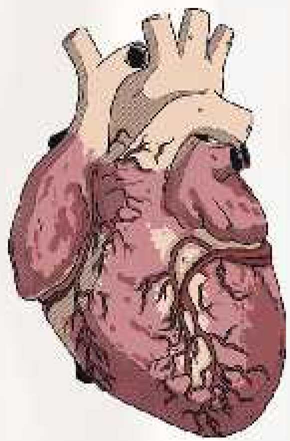
What other organs inside your body will have kept on moving?

Types of Muscle



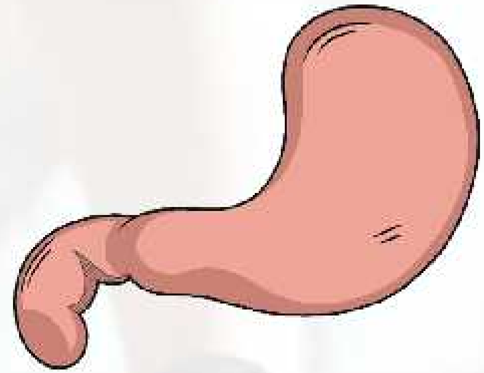
Skeletal Muscle

- the only type of muscle that we consciously control
- contracts to make parts of the body move



Cardiac Muscle

- only found in the heart
- involuntary muscle
- responsible for pumping blood around the body



Smooth Muscle

- found inside organs like the small intestine, stomach and blood vessels
- involuntary muscle.
- contracts to move substances through the organ

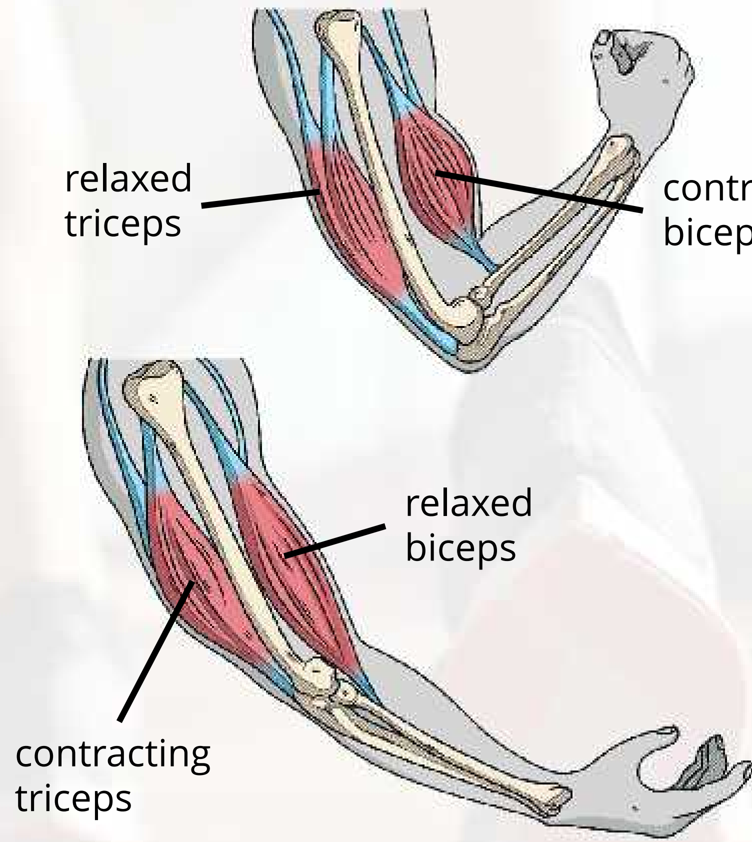
Antagonistic Muscles

Muscles can’t push; they can only pull.

This means that they have to work together to cause movement. A pair of muscles that work together are called antagonistic muscles.

When one muscle contracts, the other muscle relaxes. The joint is pulled in one direction, resulting in movement.

To move in the other direction, the first muscle relaxes and the second muscle contracts.



Modelling Antagonistic Muscles

Scientific models can help to us visualise things that we cannot see for ourselves. We can't easily observe human arm muscles to study them, so models help us to explore how they work instead.

Models are not usually a perfect representation of the real thing. Each model will have strengths and weaknesses that make it useful in some situations and less useful for others.

We are going to evaluate four different models of the antagonistic muscles (biceps and triceps) that move the arm.

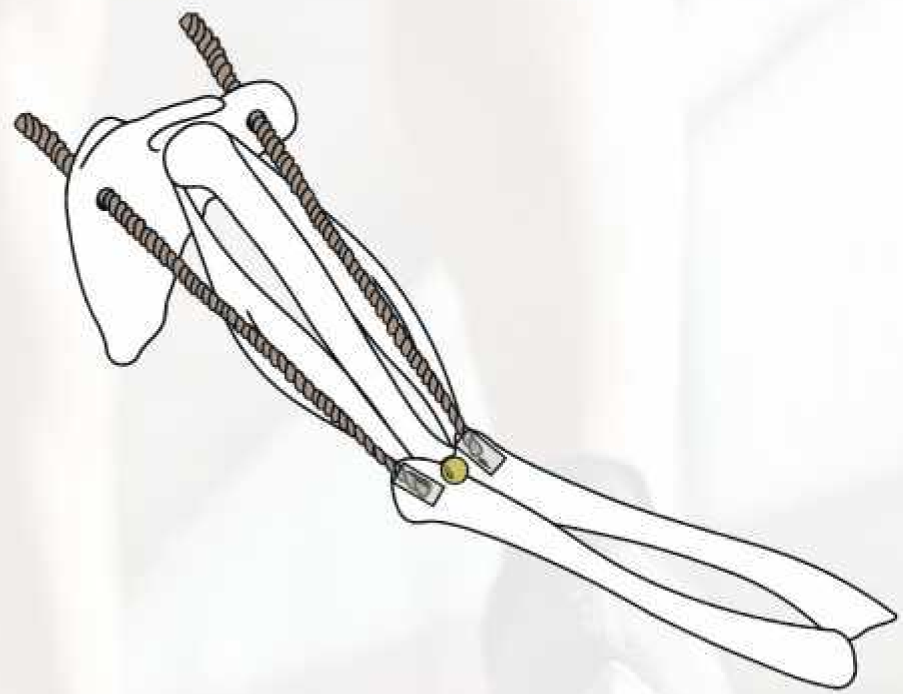
Paper Model

Follow the instructions to make a paper model of the arm.

What happens when you pull the top string?

What happens when you pull the bottom string?

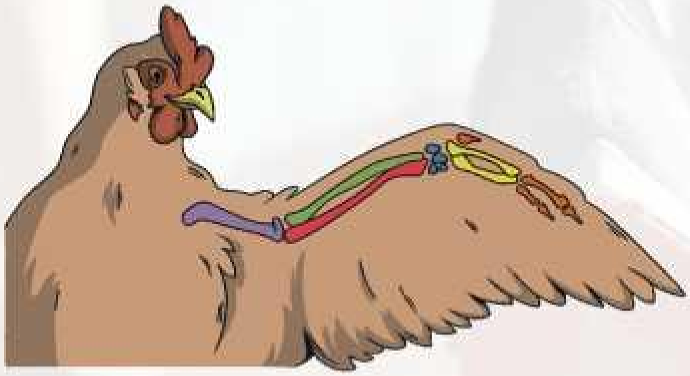
What are the strengths and weaknesses of this as a model?



Animal Model

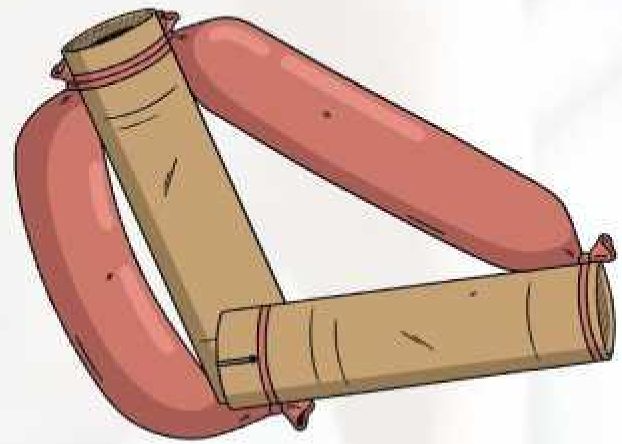
The bones in your arms are similar to the bones in the wing of a bird.

The bones, muscles and other tissues that make the wings of a chicken move work in the same way as the bones, muscles and tissues in your arms.



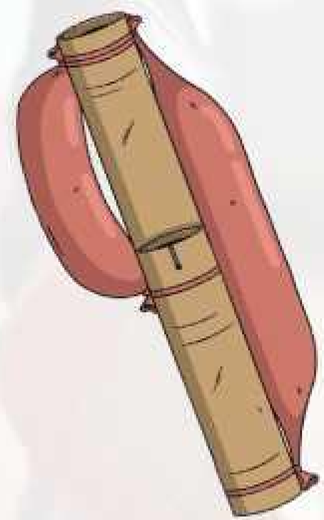
This means that we can learn things about how the human arm works by studying the chicken wing. By using animal models, researchers can carry out experiments that they would not be able to do with humans.

Balloon Model 1



The cardboard tubes represent bones and the balloons represent muscles.

When the forearm is moved up, the bicep balloon gets squashed. This models a contracted bicep muscle.



When the forearm is moved down, the bicep stretches again. The triceps balloon becomes a little smaller, representing a contracted triceps muscle.

Balloon Model 2

Balloons are inserted into a tube made from straws that bend. A tube is attached to the balloon so that it can be blown up. These structures represent the muscles. The tubes are attached to the bones by strings that represent the tendons.

When the biceps balloon is blown up, the straws bend outwards and pull the end caps towards each other. This pulls on the strings (tendons) and lifts the arm. When the triceps balloon is blown up the arm moves in the opposite direction. The inflation of the balloon represents muscle contraction.

Muscle Strength

The different muscles in your body have different strengths.

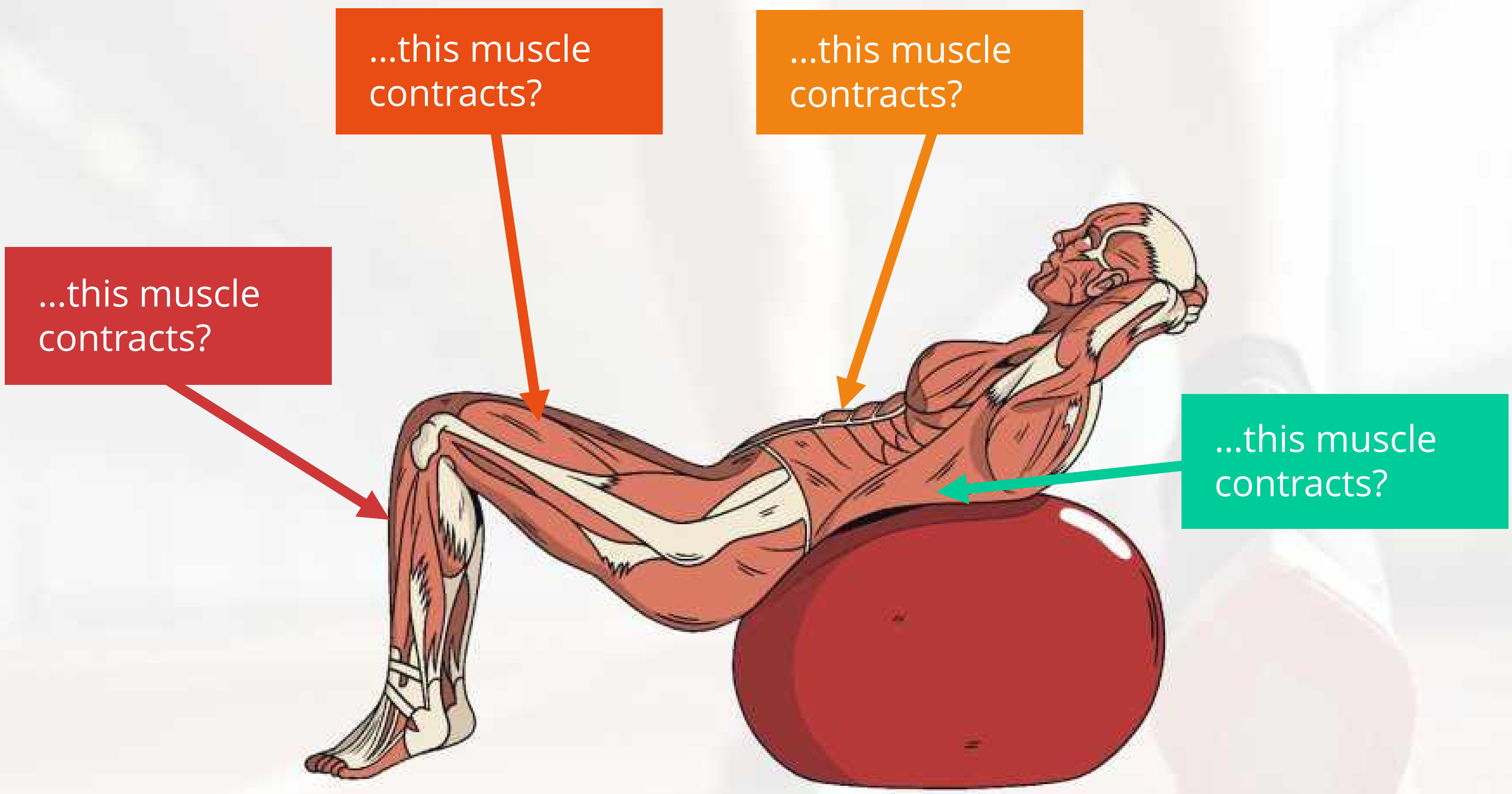
The strength of a muscle can be measured by how much force the muscle exerts. Force is measured in newtons (N).

Pushing **down** on a set of scales will measure the force exerted by the triceps.

Pushing **up** on a set of scales will measure the force exerted by the biceps.

Squeezing a hand dynamometer will measure the force exerted by the hand muscles.

What Will Happen If...?



Cells and Organisation
Muscles

Teacher Note

This resource includes photographs of raw chicken wings. Please be mindful of students in your class who may not wish to see these or participate in the dissection.

Learning Objective

To understand how muscles interact with different tissues in the body to cause movement.

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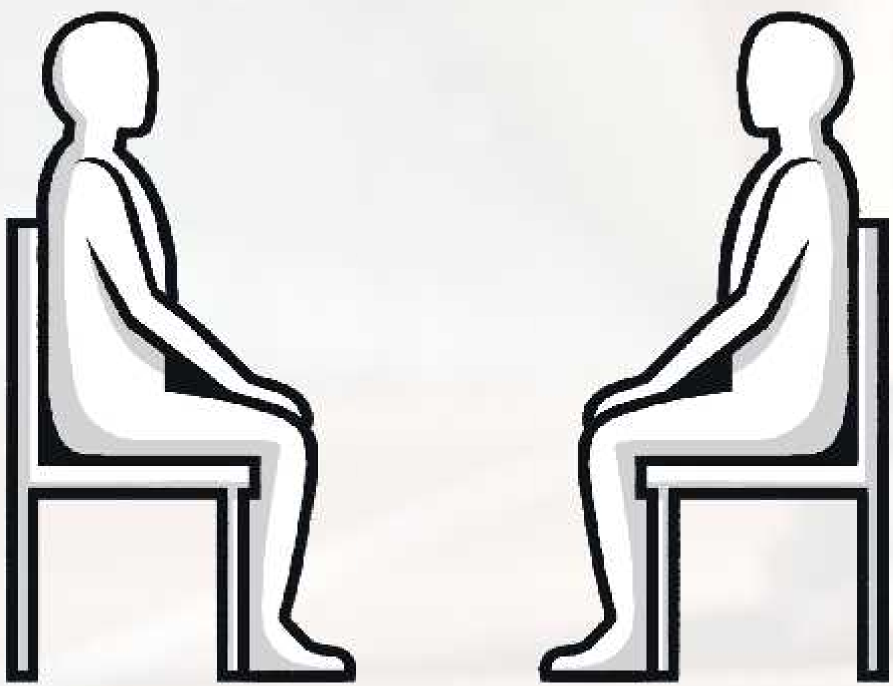

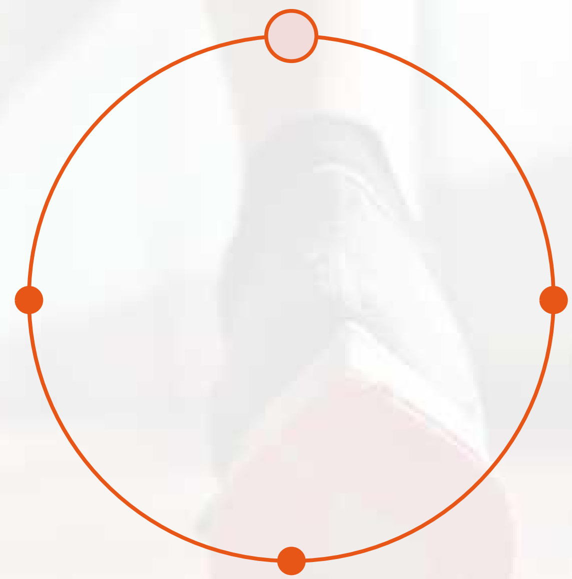

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Don’t Move a Muscle

Raise your hand if you think you managed to stay completely still for the whole 30 seconds.

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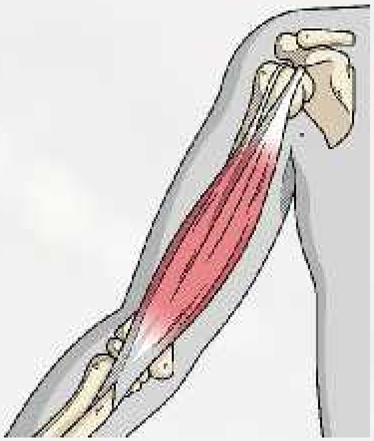
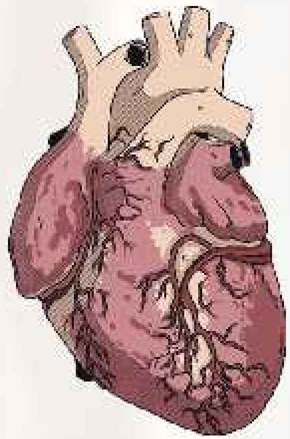
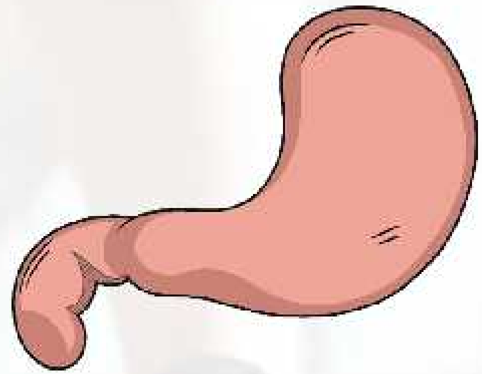
What other organs inside your body will have kept on moving?

Types of Muscle







Skeletal Muscle

- the only type of muscle that we consciously control
- contracts to make parts of the body move

Cardiac Muscle

- only found in the heart
- involuntary muscle
- responsible for pumping blood around the body

Smooth Muscle

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Body Plans

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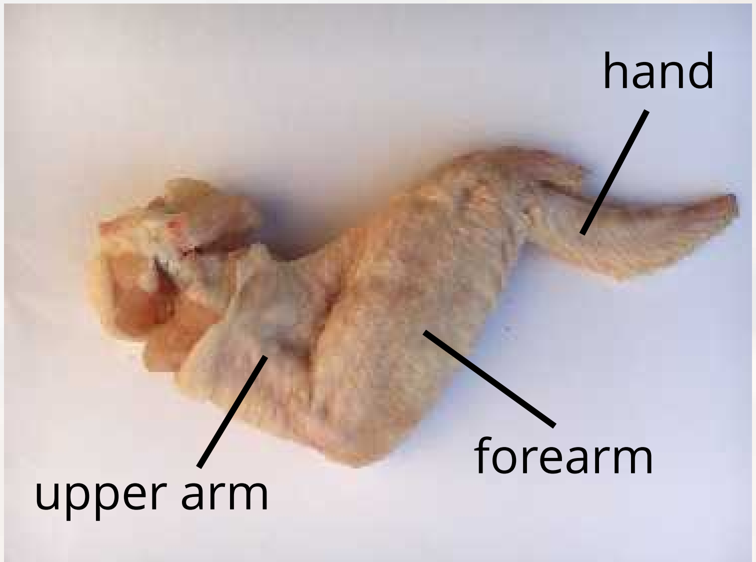
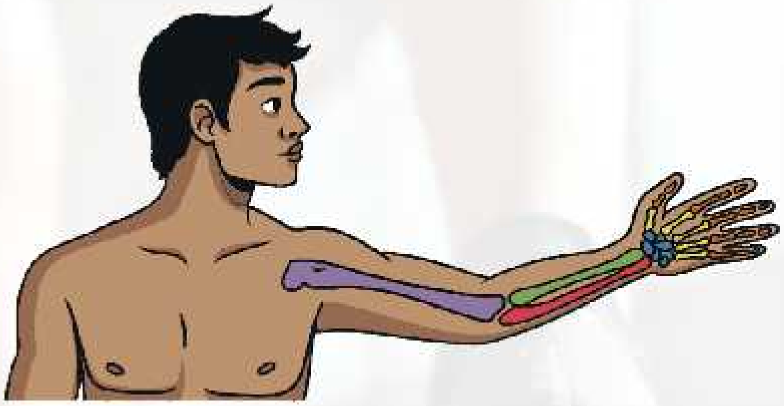
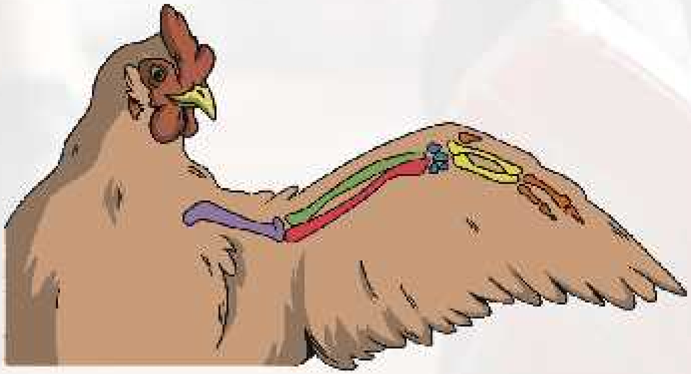






Risk Assessment

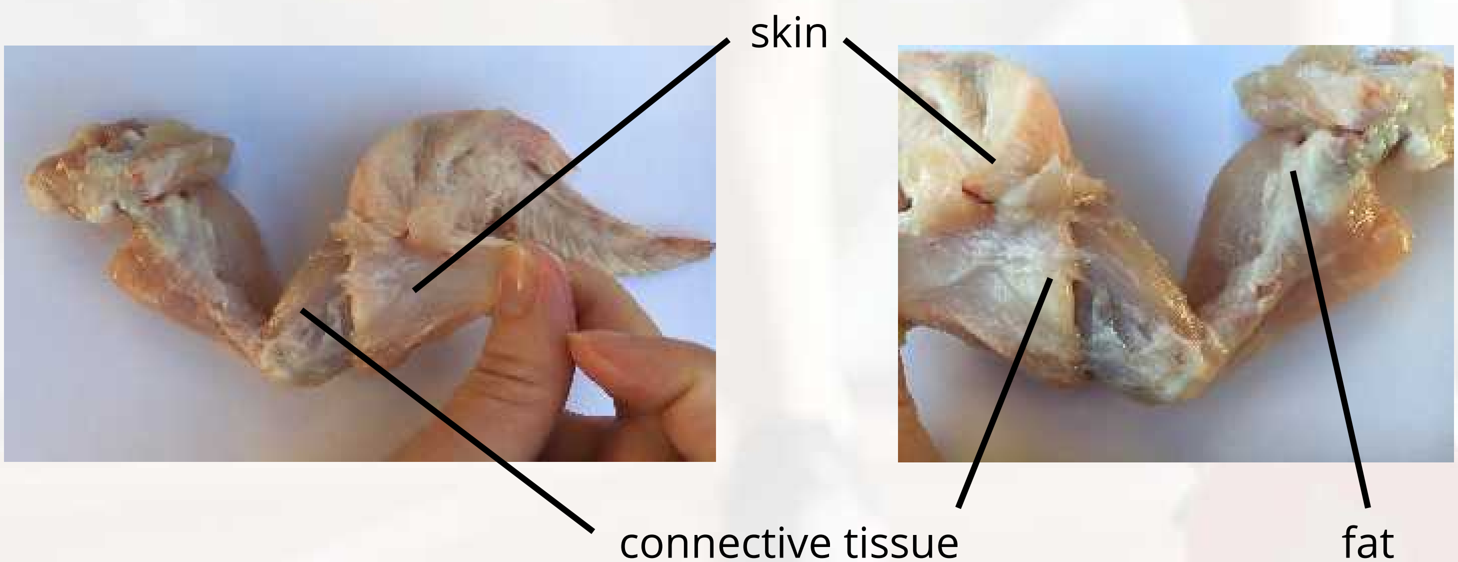
Hazard	Harm It Can Do	How You Will Minimise the Risk
disinfectant	Can be hazardous if ingested. May cause irritation.	Do not taste. Avoid contact with skin. Wear goggles.
dissection tools	The sharp edges and points can pierce or cut the skin.	Cut away from your body and other people. Ensure the floor is clear of obstacles. Carry the tools around the room in a tray. If cuts occur, apply pressure to the wound and inform teacher.
raw chicken	Uncooked chicken may contain *Salmonella* bacteria which can cause food poisoning.	Do not taste or eat any of the chicken. Do not touch your face, other people or other equipment during the dissection. Once the dissection is finished, wash your hands with antibacterial handwash.

Chicken Wing Dissection

Carefully peel back the **skin** from the shoulder down to the wing tip.

Use the scissors to cut any connective tissue that is holding the skin to the muscle.

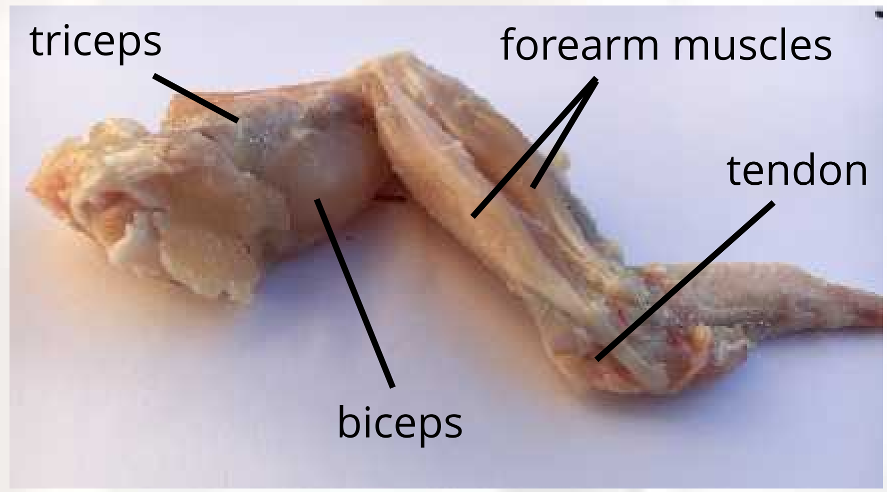
Take care not to cut any of the muscle.



Chicken Wing Dissection

Identify the four main **muscles** of the chicken wing. This is the pink, pale tissue.

Identify the **tendons**. This is the tough, white tissue that connects the muscle to the bone.



Hold each end of the wing and gently pull them away from each other. What happens to the muscles?

Gently straighten the wing then hold only the shoulder end of the wing. Pull on the bicep. What happens?

Now gently pull on the forearm muscles, one at a time. Can you make the wing wave hello?

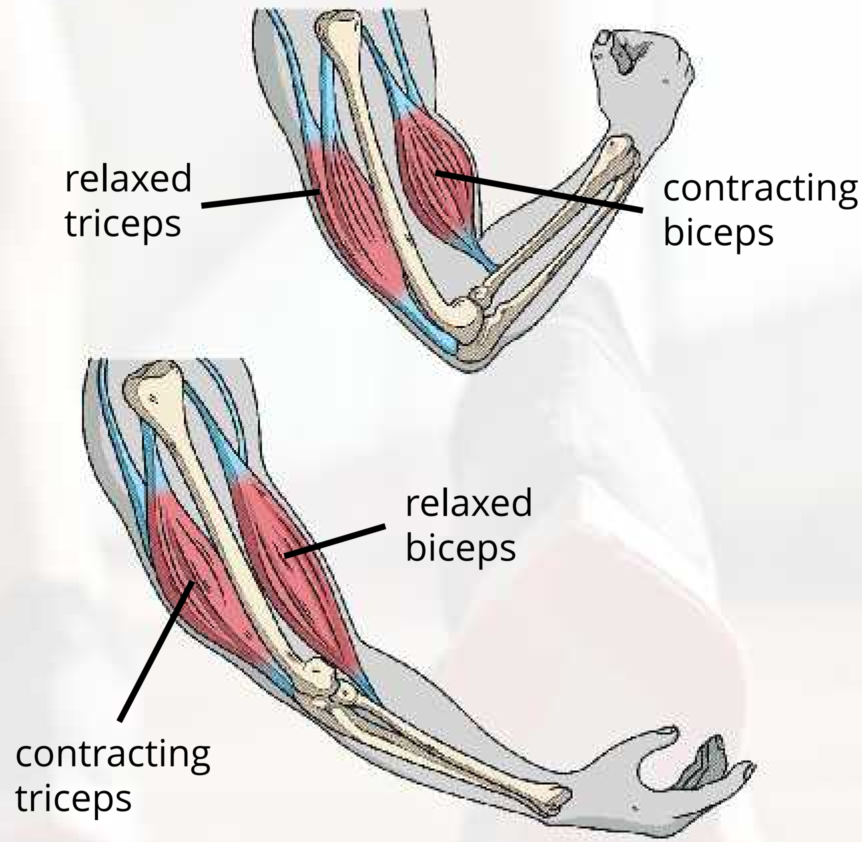
Antagonistic Muscles

Muscles can't push; they can only pull.

This means that they have to work together to cause movement. A pair of muscles that work together are called antagonistic muscles.

When one muscle contracts, the other muscle relaxes. The joint is pulled in one direction, resulting in movement.

To move in the other direction, the first muscle relaxes and the second muscle contracts. This is what you saw when you made your chicken wing wave hello.



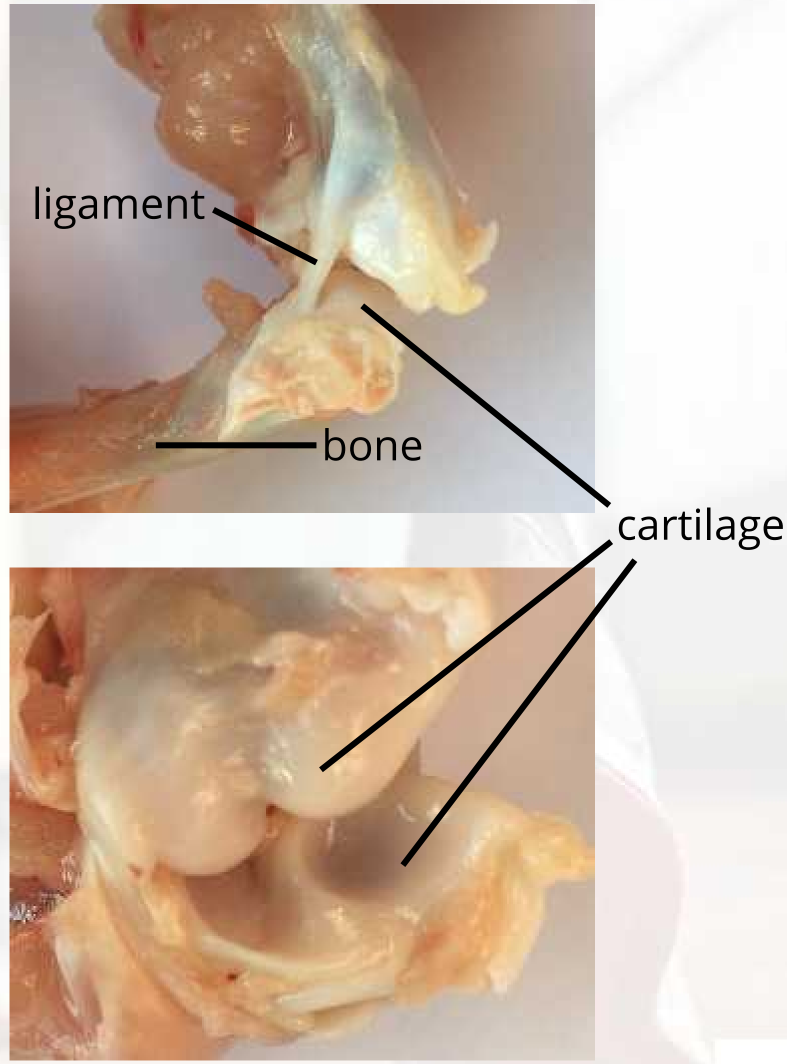
Chicken Wing Dissection

Cut the tendons around the elbow and pull away the muscles.

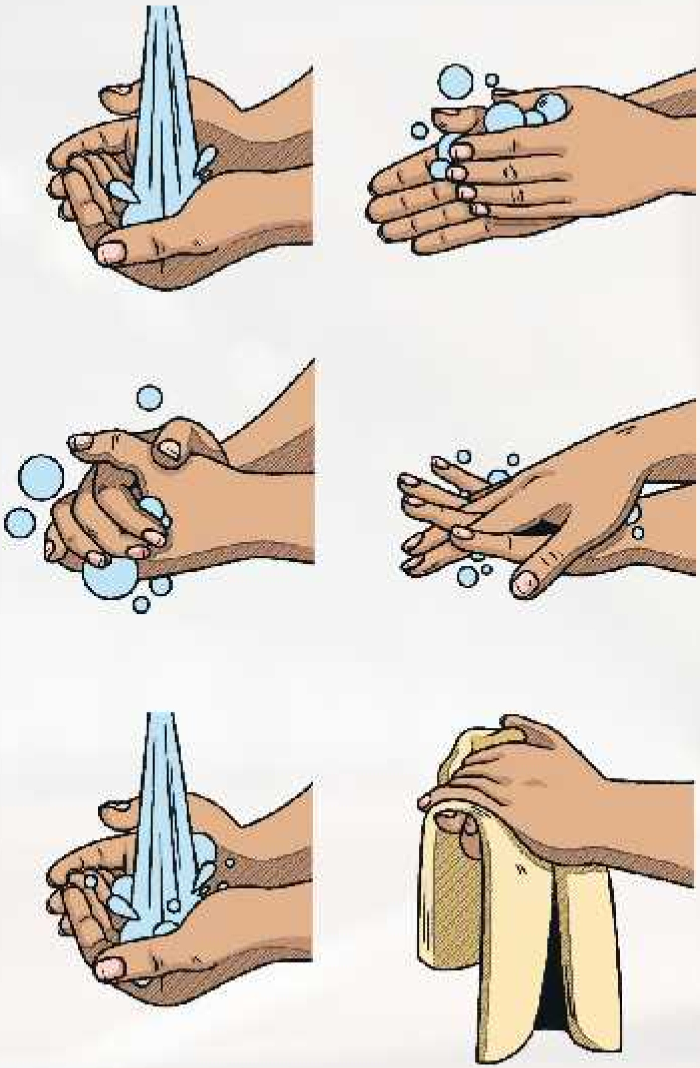
Pull gently on the two **bones** to open up the joint. Identify the tough, white **ligaments** that connect the two bones across the joint.

Cut the ligaments and have a look at the ends of the bones. What type of joint is this?

Touch the cartilage at the ends of the bones, how does it feel? How is this different from the cartilage further down the bone? Scrape both and see how they are different.



Clear Away



Scrape all of the chicken bits into the bin.

Put all tools into the buckets of disinfectant.

Without touching the tap with your hands, wash your hands thoroughly with antibacterial handwash. Don't forget to clean under your nails and around your thumbs.

Record Your Observations

Tissue	Appearance (What does it look like?)	Texture (What does it feel like?	Function (What is its job?)
skin			
muscle			
tendon			
ligament			
cartilage			
bone			

Record Your Observations

Tissue	Appearance (What does it look like?)	Texture (What does it feel like?	Function (What is its job?)
skin	pale, pinkish colour	bumpy	to protect the body from the outside environment
muscle	pink, rounded	smooth can be squashed	to contract to bring about movement
tendon	white, long and narrow strip	strong, smooth	to connect a muscle to the bone
ligament	white, long and narrow strip	strong, smooth	to connect one bone to another across a joint
cartilage	bright white, shiny	very smooth and slippery can be scratched	to allow the bones to move across each other at a joint without rubbing against each other, reduces friction at the joint
bone	dull white/grey	hard difficult to scratch	to support the body and help it to move, produces blood cells

Modelling Antagonistic Muscles

Scientific models can help to us visualise things that we cannot see for ourselves. We can't easily observe human arm muscles to study them, so models help us to explore how they work instead.

Models are not usually a perfect representation of the real thing. Each model will have strengths and weaknesses that make it useful in some situations and less useful for others.

We are going to evaluate four different models of the antagonistic muscles (biceps and triceps) that move the arm.

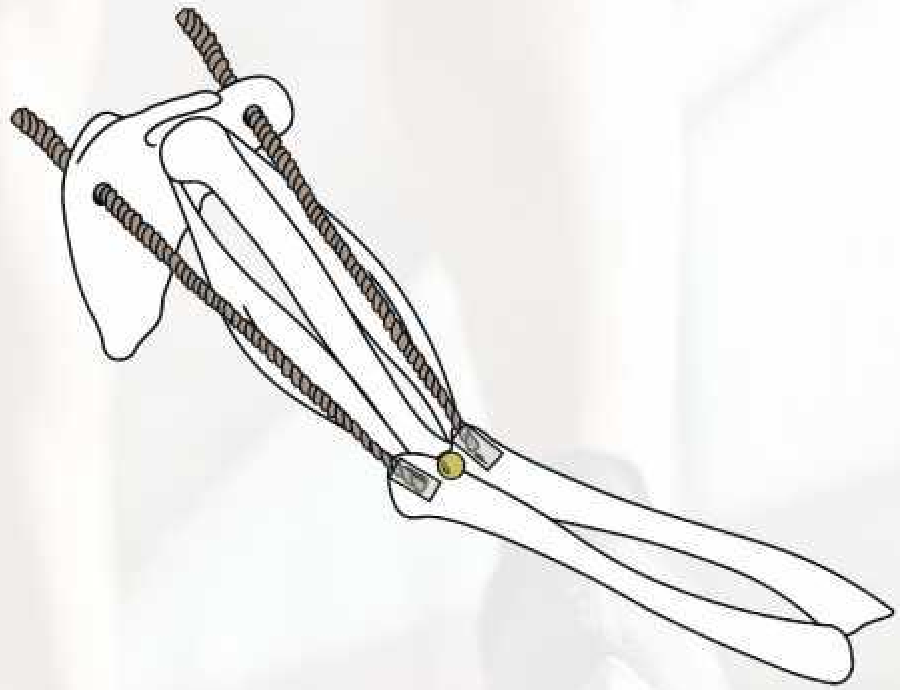
Paper Model

Follow the instructions to make a paper model of the arm.

What happens when you pull the top string?

What happens when you pull the bottom string?

What are the strengths and weaknesses of this as a model?

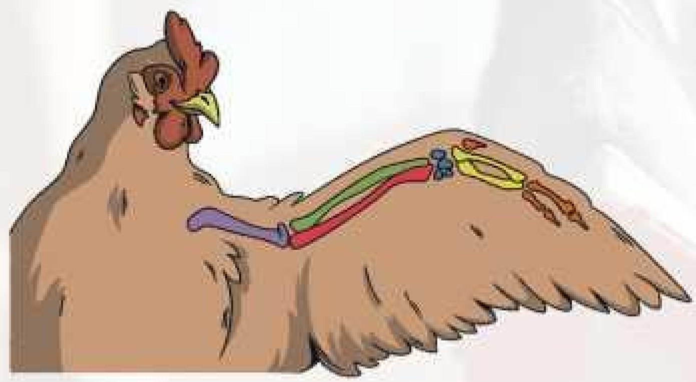


Animal Model

The bones in your arms are similar to the bones in the wing of a bird.

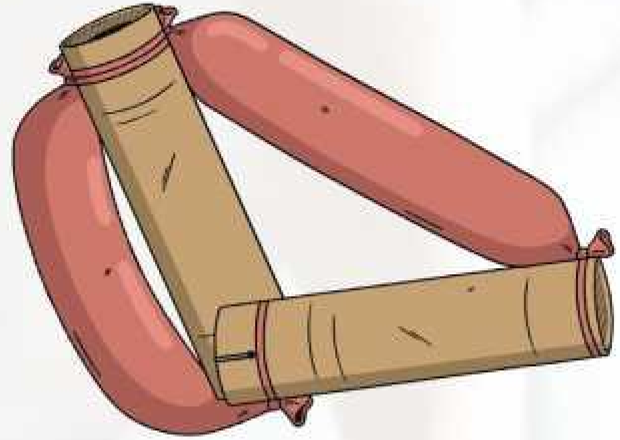
The bones, muscles and other tissues that make the wings of a chicken move work in the same way as the bones, muscles and tissues in your arms.

This means that we can learn things about how the human arm works by studying the chicken wing. By using animal models, researchers can carry out experiments that they would not be able to do with humans.



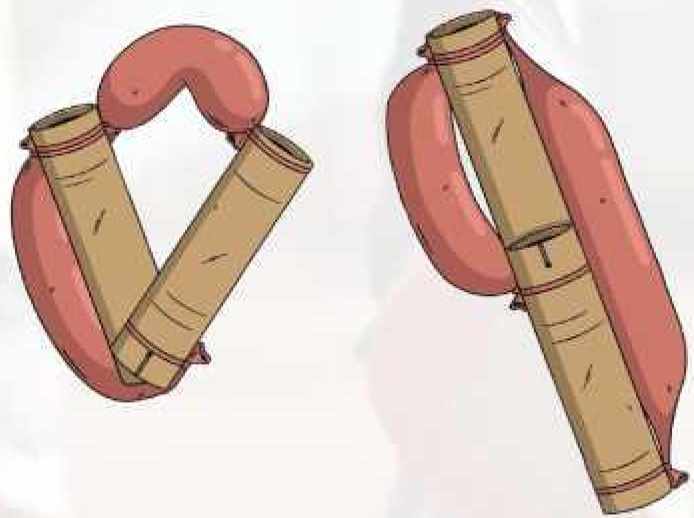
Balloon Model 1

The cardboard tubes represent bones and the balloons represent muscles.



When the forearm is moved up, the bicep balloon gets squashed. This models a contracted bicep muscle.

When the forearm is moved down, the bicep stretches again. The triceps balloon becomes a little smaller, representing a contracted triceps muscle.



Balloon Model 2

Balloons are inserted into a tube made from straws that bend. A tube is attached to the balloon so that it can be blown up. These structures represent the muscles. The tubes are attached to the bones by strings that represent the tendons.

When the biceps balloon is blown up, the straws bend outwards and pull the end caps towards each other. This pulls on the strings (tendons) and lifts the arm. When the triceps balloon is blown up the arm moves in the opposite direction. The inflation of the balloon represents muscle contraction.

Muscle Strength

The different muscles in your body have different strengths.

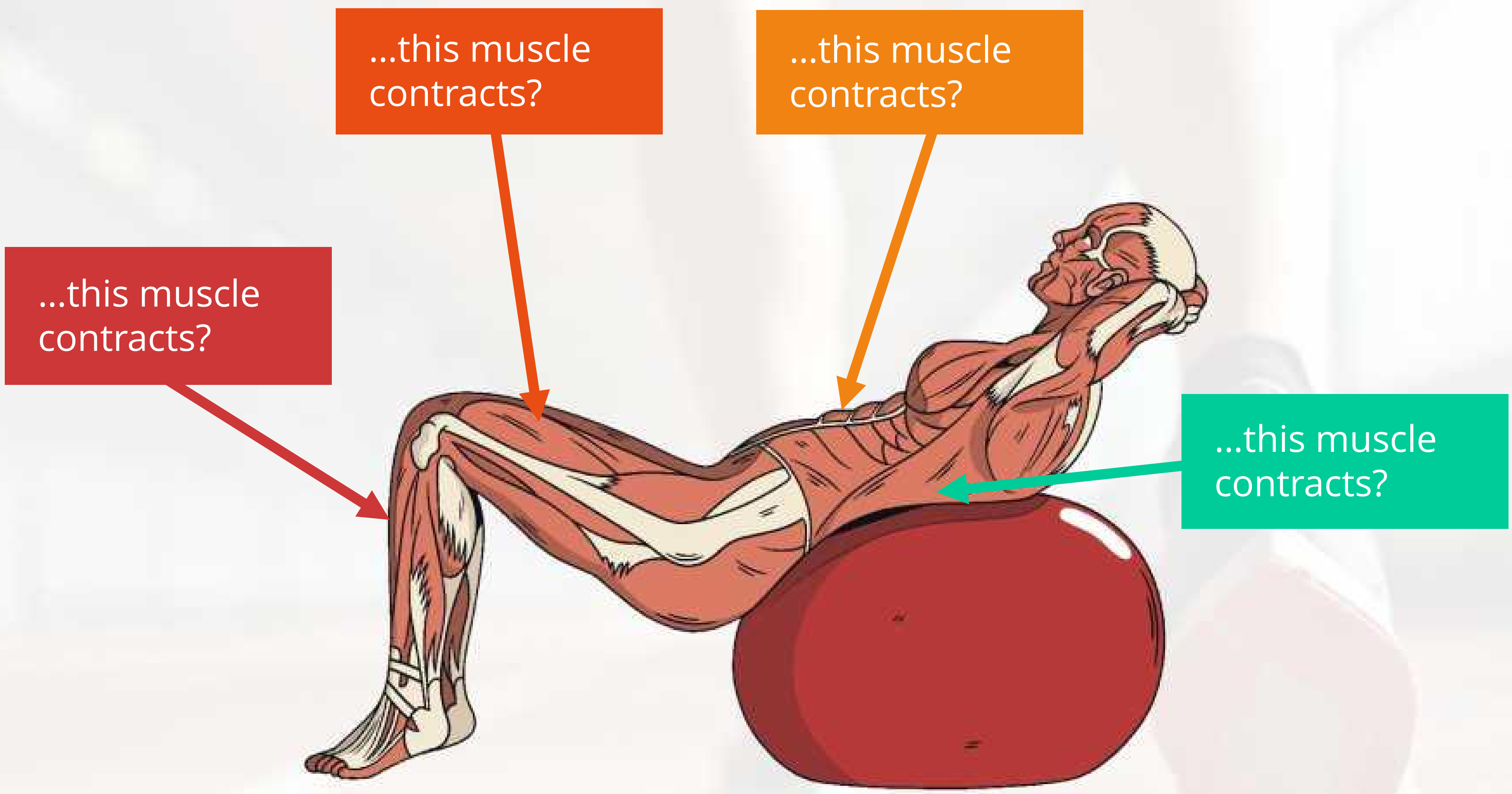
The strength of a muscle can be measured by how much force the muscle exerts. Force is measured in newtons (N).

Pushing **down** on a set of scales will measure the force exerted by the triceps.

Pushing **up** on a set of scales will measure the force exerted by the biceps.

Squeezing a hand dynamometer will measure the force exerted by the hand muscles.

What Will Happen If...?



Muscles
Teaching Ideas

Learning Objective:
To understand how muscles interact with different tissues in the body to cause movement.

Success Criteria:
- To identify the different tissues that connect bones and muscles.
- To explain why some organs contain muscle tissue.
- To discover how an antagonistic pair of muscles work together.

Context
Students will have studied the skeleton and joints in previous lessons. In this lesson, they will learn how muscles cause movements of the skeletal system.

Resources

If the dissection is carried out:
chicken wing, dissection scissors, dissection board or tray, disinfectant, antibacterial handwash

If paper models are made:
paper, split pins, string, sticky tape

If balloon models are made:
straight balloons, string, cardboard tubes, straws

Note: This lesson pack includes an optional chicken wing dissection and some of the resources have photos of raw chicken wings to guide students in the process. These resources have been highlighted in the learning activities below. If staff or students do not wish to see these photos, the **Muscles Lesson PowerPoint without Dissection** should be used for this lesson.

Starter

Don't Move a Muscle

The purpose of this starter is to highlight to the students that not all of our muscles are used for moving joints, and that we don't have voluntary control over all of them.

Challenge students to remain completely still for 30 seconds. You could ask them to sit in pairs opposite each other to keep an eye out for their peer moving. A 30 second timer is provided on the slide. Next, the slide asks students to raise their hands if they think they were still for the whole 30 seconds. You could ask their partner if they agree. They are asked if they blinked or breathed during the 30 seconds. The final question prompts them to think about the other organs inside their body that might have been moving, even if their joints were still.

Students are then introduced to the different types of muscle. At this point students could complete the first two questions on the **Muscles Worksheet** (or questions 1, 3 and 4 on the support version). Alternatively, there is an opportunity to complete the worksheet later in the lesson, or for homework.

Main Activities

The next slide shows the similarities between the human arm and chicken wing. You could ask students to identify the differences between them, and they may notice that some of the bones that make up our fingers are fused in the bird. Researching the body plan of the wing of a bat might be an interesting homework task as a bat wing is more closely related to a human arm than a bird wing.

You could now complete the dissection activity describe below. If a dissection is not suitable for your group, or if there are students who will not be carrying out the dissection, the muscle modelling activity could be completed instead.

Chicken Wing Dissection

A risk assessment is shown on the slide and on the **Chicken Wing Dissection Method sheet**. Additional safety information and notes are given on the **Chicken Wing Dissection Teacher and Technician Notes**. The **Chicken Wing Observation Sheet** provides space for students to record any observations about the appearance and texture of each part. To avoid transfer of fluid from the chicken to students' work, students should not complete the sheet while carrying out the dissection.One student could be responsible for completing the sheet away from the dissection area, as long as they do not touch the chicken or equipment.

Alternatively, students could complete the worksheet after the dissection has been cleared away and they have washed their hands. The same table is provided on the PowerPoint to discuss as a class if needed.

The slides include step-by-step instructions for carrying out the dissection. The practical works best if you display one slide at a time and allow students to carry out those steps before moving on, rather than working through all of the slides before they begin. Photographs are included on the slides to help students identify the correct tissues on their chicken wing. Encourage students to move slowly through the practical so that they do not accidently cut the incorrect tissues. It may be useful to have some spare wings available in case this happens.

Once the skin has been removed from the chicken wings, allow the students to take time to manipulate the muscles. When holding the top of the bone (where the shoulder would be), they should be able to raise the wing by pulling on the biceps muscle and lower it by pulling on the triceps muscle.

Alternating pulling on the muscles in the forearm will allow them to wave the tip of the wing. This is a great way for students to develop an understanding of how antagonistic muscles work together. A slide in the PowerPoint provides an explanation of this if required. If you have a visualiser, this could be used to model the movement to the whole class, or the **Chicken Wing Video** could be played to show the process.

As an alternative to a whole class dissection, you could demonstrate the practical underneath a visualiser or with students grouped around a desk. There is an optional clean up slide to use if your class will need prompting to make sure they clean up properly.

Modelling Antagonistic Muscles

The modelling antagonistic muscles resources include information about four different models of the biceps and triceps muscles. Students could use the information on the **Muscle Model Information Sheets** to complete the **Evaluating Muscle Models Worksheet** which asks them to summarise the strengths and weaknesses of each model. Two versions of the **Muscle Model Information Sheets** are provided. One version includes a photograph of a raw chicken wing, while the second version has the photograph omitted. The second version should be provided for students who do not wish to view the chicken wing.

As the chicken wing model is included in the resource, it could be a good way to follow the dissection activity if you have time in the lesson. However, students do not need to have completed the dissection to carry out the evaluation activity.

An **Antagonistic Muscle Paper Model Template and Instructions** are provided so that students can build this model and stick it into their books. Students do not have to have built the model to complete the evaluation task. However, this activity will be particularly useful for students that do not carry out the dissection.

The final two models use balloons in different ways to model the movement of the muscles. You could build these in advance of the lesson to demonstrate to students or allow them to explore the different models in a circus-style activity. Students will be able to complete the tasks without having the models available.

If students do not carry out this activity in the lesson, the slides can be skipped and the **Evaluating Muscle Models worksheet** could instead be provided as a useful homework activity linked to the lesson.

Muscles Worksheet

Once students have explored antagonistic muscle action in at least one of the ways above, the **Muscles Worksheet** provides space for them to record their learning.

Muscle Strength

Students are told that the strength of a muscle can be measured by how much force the muscle exerts and some ways of doing this are shown on the PowerPoint. If you would like to explore this further, the **Measuring Muscle Strength worksheet** gives instructions for measuring the strength of the biceps and triceps muscles using bathroom style scales. The activity is best carried out using scales that measure in newtons, but if these are not available the **Measuring Force with a Scale sheet** explains how to convert a reading in kilograms to newtons.

The PE department are likely to have a hand dynamometer so you may be able to borrow one to demonstrate grip strength during the lesson too.

The **Measuring the Force Exerted by Muscles Worksheet** provides space for students to record their measurements for the different muscles and compare them with other students' measurements. Example measurements are provided on the answer sheet that you could use if it is not possible to carry out the measurements in class.

Plenary

An image of a person leaning back over a gym ball with their muscles visible is presented on the slide. One at a time on a click, different muscles are indicated and students are asked what movement the contraction of that muscle will bring about.

Muscles **Answers**

1. What is a muscle?

   A muscle is a bundle of tissue that can contract to bring about movement.

2. Explain why muscle tissue is found in some organs. Include two examples in your answer.

   Organs contain muscle if they need contractions to function, for example, to help move substances.

   Possible examples include:

   - **The heart includes cardiac muscle to pump blood.**
   - **The organs in the digestive system include smooth muscle to help push food through the intestines.**
   - **The stomach walls include smooth muscle to churn the food.**
   - **The artery walls include smooth muscle to move blood through the body.**
   - **The smooth muscle in the bladder wall helps to expel urine from the body.**
   - **In the bronchi and bronchioles, smooth muscles regulate the flow of air into the lungs.**

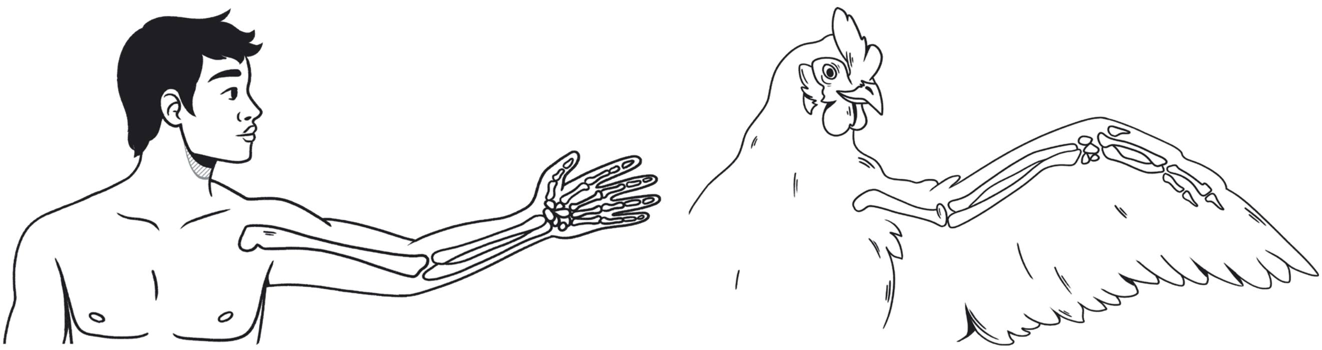
3. Give the term used to describe two muscles that work together in a pair to cause movement.

   antagonistic

4. Explain why two muscles are needed to bend a joint.

   Muscles can only pull, they can't push. This means that they must work in pairs at a joint. When one muscle contracts, the other relaxes. This pulls the joint in one direction, causing movement. To move the joint in the other direction, the first muscle must relax while the second contracts.

The diagrams below show the structure of a human arm and the structure of a chicken wing.



5. Explain why we can use a chicken wing as a model to help us understand the movement of a human arm.

   The chicken wing has a similar body plan to the upper arm and forearm of a human. The muscles, bones and other tissues cause movement in the same way, so studying the movement of a chicken wing helps us to understand the human arm.

Muscles Answers

1. What is the function of muscle tissue?

   Tick **one** box.

   - [x] to cause movement
   - [ ] to connect bones together
   - [ ] to prevent bones from rubbing against each other
   - [ ] to provide support

2. What is the name of the tissue that connects muscles to bones?

   Tick **one** box.

   - [ ] cartilage
   - [ ] joint
   - [ ] ligament
   - [x] tendon

3. Explain why cardiac muscle is found in the heart.

   The heart contains (cardiac) muscle to pump blood around the body.

4. Explain why smooth muscle is found in the stomach.

   The stomach contains (smooth) muscle to churn food and move food through the organ to the small intestine.

5. Complete the sentences using the key words.

antagonistic	contracts	movement	pairs	pull	push	relaxes

Muscles can only **pull**, they can't **push**. This means that they must work in **pairs**. When one muscle **contracts**, the other **relaxes**. This pulls the joint in one direction, causing **movement**. Muscles that work together in this way are called **antagonistic** muscle pairs.

Muscles

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   Tick **one** box.

   ☐ to cause movement
   ☐ to connect bones together
   ☐ to prevent bones from rubbing against each other
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   ☐ ligament
   ☐ tendon

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   ____

   ____

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   ____

   ____

   ____

   ____

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antagonistic	contracts	movement	pairs	pull	push	relaxes

Muscles can only ______________, they can't ______________. This means that they must work in ______________. When one muscle ______________, the other ______________. This pulls the joint in one direction, causing ______________________. Muscles that work together in this way are called ______________________________________ muscle pairs.

Muscles

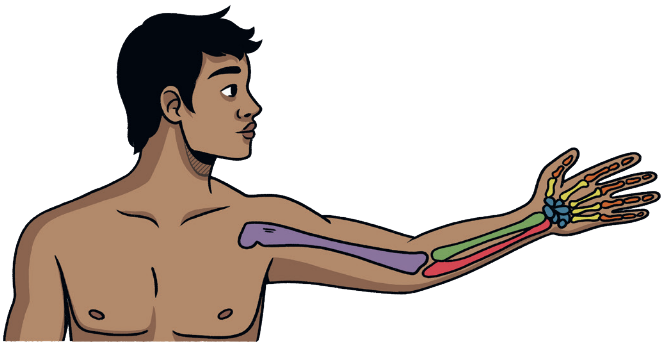
1. What is a muscle?

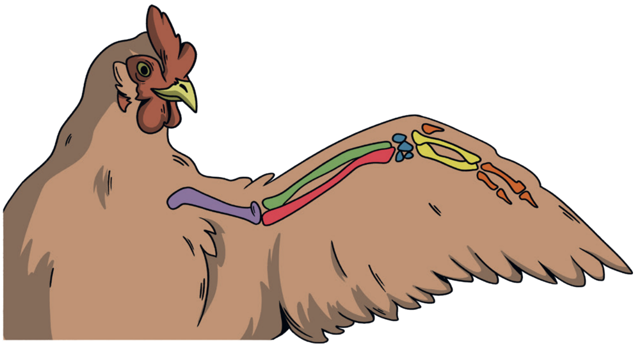
2. Explain why muscle tissue is found in some organs. Include **two** examples in your answer.

3. Give the term used to describe two muscles that work together in a pair to cause movement.

4. Explain why two muscles are needed to bend a joint.

The diagrams below show the structure of a human arm and the structure of a chicken wing.





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