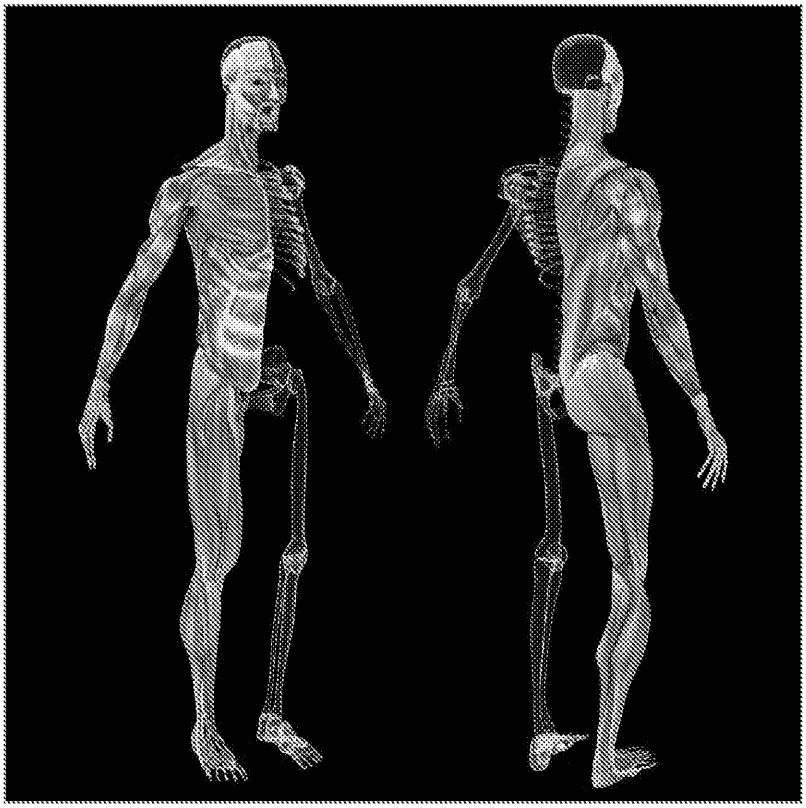
Zig Zag Education

Science

KS3

2013 National Curriculum



Bones and Muscles

Biology Topic Pack II for KS3 Science

Download support files from zzed.uk/productsupport

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POD 12279

Contents

Teachers' Introduction

Welcome to the Key Stage 3 Bones and Muscles Topic Pack, which should be used in Year 7, or possibly Year 8, depending on your school's chosen learning route for Science. The pack has been designed to support learning of this topic by acting as an accompaniment to the teacher's classwork, and should engage students of all abilities. It can be given to students before lessons, or may be used as cover lesson work or homework, and the end-of-topic questions work well as a formative assessment. It is assumed that your learners will have **already covered** the following content, much of which will be covered in our KS3 Biology Topic Pack I (Cells, Tissues and Organs):

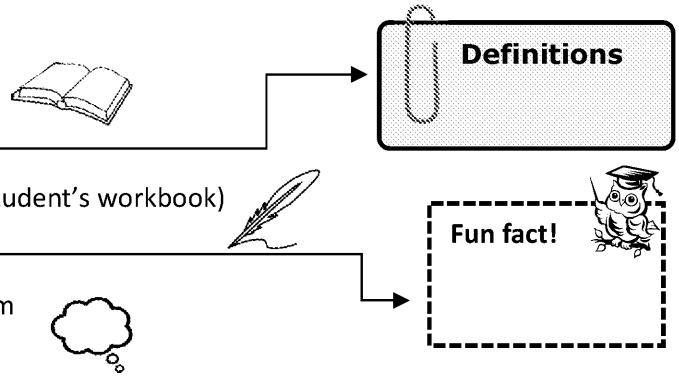
- structure of animal cells
- cells, tissues, organs and organ systems
- specialised cells, possibly including red blood cells
- from their Primary learning stages: some roles of the skeleton and muscles
- the difference between mass and weight (for the Working Scientifically activity)

The National Curriculum points covered by this topic pack are:

- the structure and functions of the human skeleton, to include support, protection, movement and making blood cells
- biomechanics – the interaction between skeleton and muscles, including the measurement of force exerted by different muscles
- the function of muscles and examples of antagonistic muscles

The topic pack includes the following components:

- Explanations and examples of the key concepts
- Key scientific terms and definitions
- Comprehension questions (to be answered in a student's workbook)
- Fun facts
- Working scientifically – focus: making a model arm and evaluating the results
- Crossword
- End-of-topic questions (to be answered in a student's workbook)*
- Answers



This topic pack covers the material seen in the following two textbooks:

- *Activate 1* (Gardom Hulme et al.): Chapter 2.4–2.6 (pp. 32–37)
- *Exploring Science 9* (Levesley et al.): Chapter 9Bda (pp. 28–29)

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*A write-on version of the end-of-topic questions is provided on the ZigZag Education Support Files system, which can be accessed via **zzed.uk/productsupport**

Why do we need a skeleton?

Humans and all other **vertebrates** have bones inside their bodies that form a **skel**

The human skeleton contains **bones** and **cartilage** and forms a framework inside the body.

Vertebrate: an animal with a spine (backbone)
Skeleton: the structure of bones and cartilage inside the body
Bone: a tissue made from specialised cells embedded in hard minerals
Cartilage: a tough, flexible tissue that protects or connects bon

The skeleton has different jobs:

- *support for the body*, which means you can stand and move without flopping over
- help with *movement* – muscles act on bones to help us walk and lift things; movement from one place to another is called **locomotion**
- *protecting organs* – the skull protects the brain, the breastbone protects the heart, and the ribcage protects the lungs
- its long bones contain **marrow** which is where *new blood cells and new bon cells are made*
- acting as a *store for the essential minerals*: **calcium** and phosphate

Locomotion: moving from one place to another, e.g. walking, running
Marrow: spongy tissue inside long bones that makes new blood cells and new bone cells
Calcium: an essential mineral found in food that is needed for strong bones
Friction: force between two moving solids that are in contact; causes wear of moving parts

The cartilage in the skeleton has different jobs:

- cartilage coats the ends of bones at moving joints to *reduce **friction** and pro*
- cartilage gives *flexibility* – the ribs are joined to the breastbone with cartilag
- cartilage gives *support* – your nose and ears contain cartilage to give them s

Q1: List three functions of the skeleton.

Q2: Name the spongy tissue found inside long bones.

Q3: Cartilage is found at the hip joints. Suggest:

(a) where, exactly, the cartilage is located in the joints

(b) the function of this cartilage

Fun fact!
There is no fixed number of bones in your body!
As a baby, you had around 270 bones. Some bones join a you grow, meaning as an adult you will have 206–213 bon

Joints

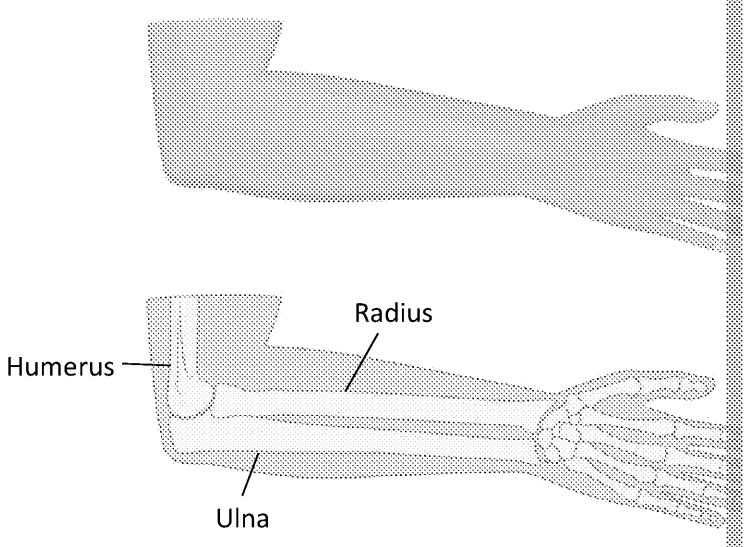
A **joint** is a location in the skeleton where two or more bones meet.

Most joints allow movement. One type of joint that allows movement is called a **hinge joint**.

Join
whe
Hin
ben

You have hinge joints at your elbow and in your fingers. The joint between your
Hinge joints allow bending only.

The picture shows the bones in the arm and hand, containing hinge joints.



Q4: List two other places in the body where you have hinge joints, apart from t

Another type of joint that allows more movement is a **ball and socket joint**.
This type of joint allows both bending and rotation. You have ball and socket join

Ball and socket joint: a joint that allows bending and rotation

Q5: Describe one difference between the movement allowed by a ball and socket joint compared to a hinge joint.

In both hinge joints and ball and socket joints, the bones that move are held toge

Some joints do not allow a
fixed joints. There are fixe

Liga
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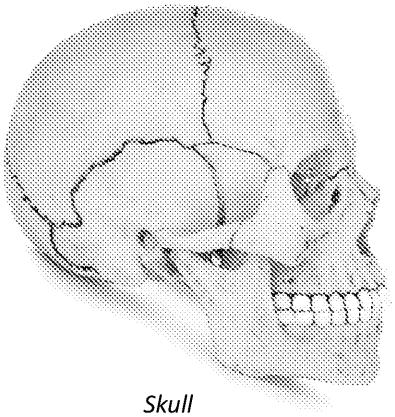
Fixe
not a



Skull

Another example of a fixed
the lower arm (the radius
each other.

Fun fact!
You have three tiny
that transmit sound
to the nerves for he
bones is just under

Muscles

Muscles are used to make the skeleton move.
Muscles are attached to bones by **tendons**.

Muscles can act in one of two ways:

1. muscles can **contract** – this requires energy from food and makes the muscle shorter so it pulls on a bone
2. muscles can **relax** – which means they are not using energy and they go slack, not pulling on a bone

Tend
attacl
Cont
pull o
Relax
so it i

When a muscle contracts, it exerts a force to pull on a bone. This will cause mov

When a muscle relaxes, it can be pulled longer by another muscle.

Fun fact
A sprain
caused b
ligament

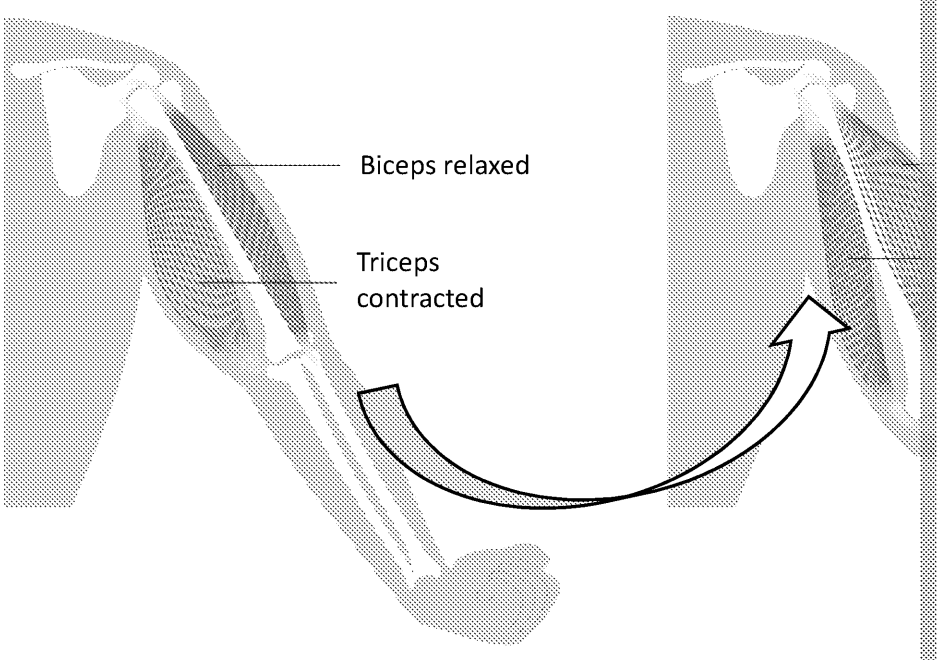
Normally, muscles do not stretch. If they stretch, this will result in injury.

Often, muscles act in opposing ways. These types of muscles are called **antagonistic pairs**.

Antago
that ca
directio
contrac

An example of an antagonistic pair is in the arm. The biceps and triceps muscles produce opposite movements around the elbow.

The biceps bends the arm up at the elbow and the triceps straightens the arm. For these movements to happen, one muscle contracts while the other relaxes.



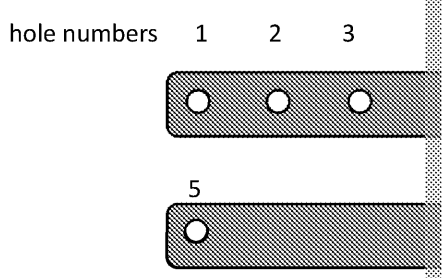
Q6: Describe what will happen to the arm when:
- (a) the biceps contracts and the triceps relaxes
- (b) the triceps contracts and the biceps relaxes
- (c) both the biceps and the triceps relax

Q7: List two other places in the body where an antagonistic pair of muscles act. movement that is produced by these muscles.

Working scientifically – making a model arm and evaluat

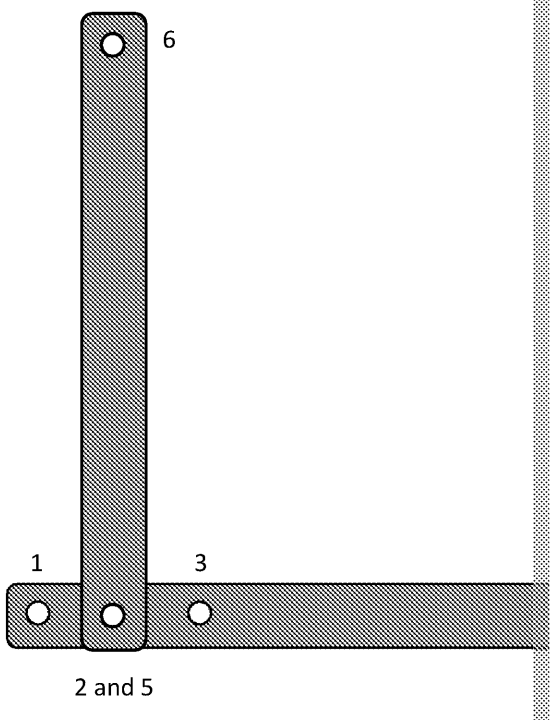
For this activity, you will need:

- ☑ two strips of wood or metal with holes drilled near both ends of each as shown – two wooden 30 cm rulers or strips of Meccano are ideal
- ☑ small nut and bolt, or brass paper fastener that folds out
- ☑ string
- ☑ scissors
- ☑ force meter
- ☑ slotted masses and mass hanger
- ☑ clamp stand



Method

1. Attach the two strips together with the nut and bolt or the paper fastener th
Make sure the 'arm' can bend freely at this joint. The strips will model the b

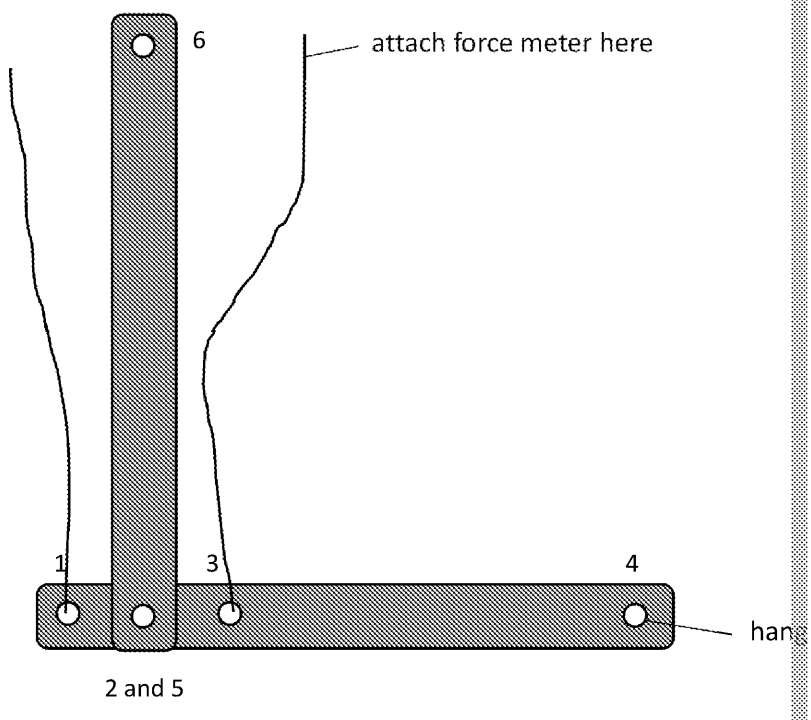


2. Tie one end of a piece of string to hole 1 and another piece of string to hole
same length as the upright strip. The strings will model the muscles in the u

3. Tie the other end of the string that connects to hole 3 to the hook on the fo
should be loose.

4. Clamp the upright strip to the clamp stand so the clamp is about halfway up
The two pieces of string will represent the muscles that pull on the lower ar

5. Hang the mass hanger through hole 4.



6. Now attach different masses to the hanger.

7. Use the force meter to pull on the string that connects to hole 3, so that the
horizontal, as in the diagram above. Keep the string vertical, which should b
the 'arm'.

8. Record the force needed to keep the 'arm' in this position while holding eac
masses and **not** weights. This is important because the unit of mass is gram
the force meter is recorded in newtons.

Results

Display your results in a table. Don't forget to include the units of each measure
Your column headers could be:

- mass hanging on arm (g)
- force needed (N)

Plot a line graph of your results with mass on the x-axis and force on the y-axis. (
bottom and the y-axis goes up the left side of the graph.)

Q8: Find the names of the bones and muscles that are modelled in your investi
Q9: Write down one way that this model is good for showing how the arm wor
Q10: Write down one way that this model is not so good for showing how the a

Q11: In this investigation, state:

(a) the independent variable [Hint: this is the variable that you decide to

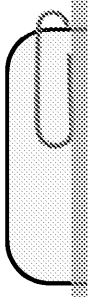
(b) the dependent variable [Hint: this is the variable that depends on wha

(c) one control variable [Hint: a control variable is something that you ke the results.]

Q12: Describe the trend or pattern in your results.

Q13: (a) How does the force needed to support any mass compare to the weig mass to weight, first convert your mass to kg, then multiply by 10; you

(b) Suggest a reason for any difference in the values in part (a).



If you have done some experiments before, you will know that:

- experiments can be easy or difficult to set up
- measurements can be easy or difficult to make
- results can be good or bad

We call these things **evaluation** of the activity.
Evaluation is often the most challenging part of any experiment.

Let's look at some examples of what might happen in this activity:

- the parts of the model arm might bend
- it might be difficult to hold the force meter without moving it
- the top part of the arm might turn in the clamp

If any of these things happens, you need to write about it. Then – the hard part – improvement that will stop it from happening.

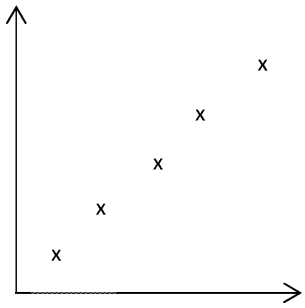
Unfortunately, just saying *'Be more careful next time.'* is not enough!

Something like *'The upper part of the model arm did not stay vertical in the clam clamps to hold it vertical.'* is much better.

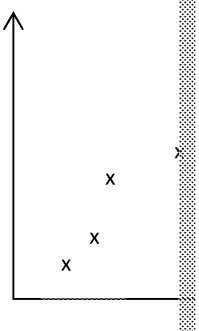
Now let's look at evaluating results.

Evaluation

Imagine two groups of students, A and B, get results that look like this on their gr



group A



group B

Both groups know that their graphs should be a straight line.
Their evaluations could read something like these:

Group A: *'Our results were good. I know this because all the points on the graph*

Group B: *'Our results were not so good. I know this because the points on the gr line. Some of the points are quite far away from a line.'*

Q14: Evaluate your results.

Use these prompts:

- I think my results are...

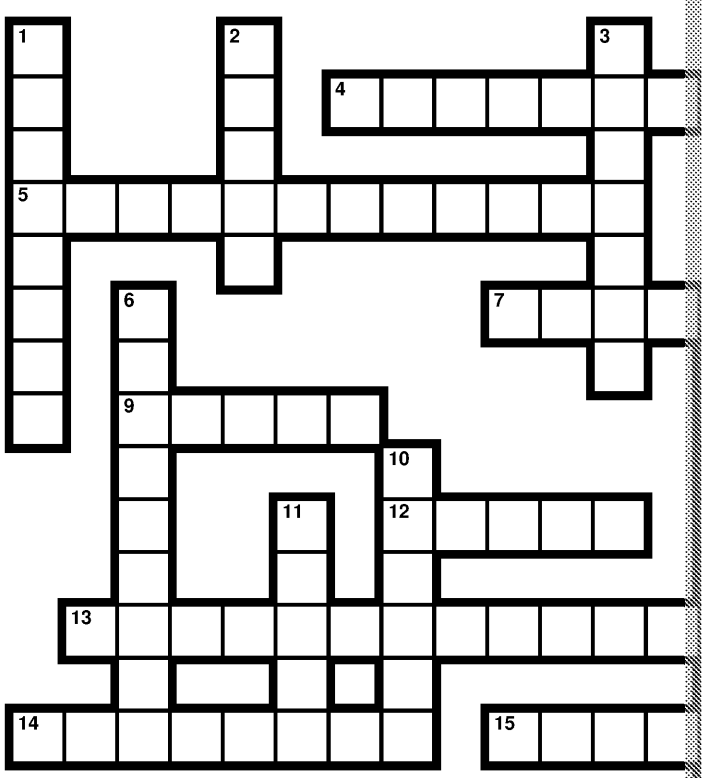
- I think this because...

Q15: Part of an evaluation involves thinking of any problems that you had and h experiment next time.

Describe any difficulties you had and suggest improvements.

[Hint: you can develop your answer to Q10 as part of your answer here.]

Crossword



Across

4 When a muscle shortens, it is said to… (8)

5 A pair of muscles that produce opposite movements (12)

7 This bone protects the brain (5)

9 Opposite of 4 Across (5) (5)

12 Joint where the arm bends (5)

13 Type of joint that allows bending and rotation (4,3,6)

14 The framework of bones and cartilage in the body (8)

15 This part of a bone makes new blood cells (6)

Down

1 Connects bon

2 Type of joint

3 Essential min

6 Found at the joints (9)

8 The scientific one place to with this (10)

10 Connects a m

11 The organ in tected by the

End-of-topic Questions

1. Choose **one** animal from this list that does **not** have a skeleton.

   elephant **human** **mouse** **gold**
   earthworm **crocodile** **frog**

2. Write down **three** functions of the skeleton in humans.

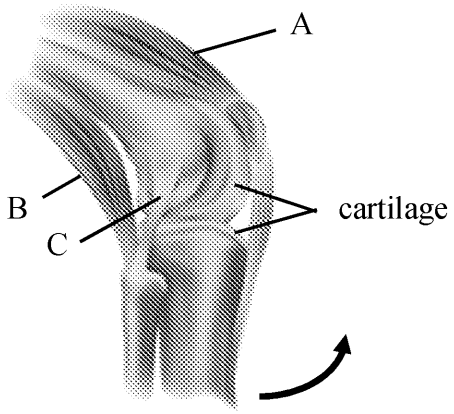
3. Explain why the number of bones varies through the life of a healthy human

4. Long bones are bones like those in the legs and arms.
   (a) Name the spongy tissue found in the inside of these bones.
   (b) Describe the function of this tissue.

5. A broken bone can heal. Suggest how this is evidence that bone is living tiss

6. The skeleton contains joints.
   (a) Describe what is meant by a joint in the skeleton.
   (b) (i) Name the type of joint that allows bending only.
   (ii) Give **one** example of where this joint is found in the arm.
   (c) (i) Name the type of joint that allows bending **and** rotation.
   (ii) Give **one** example of where this joint is found in the arm.
   (d) (i) Name the type of joint that does **not** allow movement.
   (ii) Give **one** example of where this type of joint is found.

7. The diagram shows the human knee joint. Two muscles, A and B, are labelle



   (a) Copy and complete the sentence using letters from the diagram. You w

   For the knee to bend in the direction of the arrow, muscle _____ must c
   and muscle _____ must relax.

   (b) Give the name for a pair of muscles that act like A and B in this diagram
   (c) (i) Name the structure labelled C.
   (ii) State the function of structure C.
   (d) Cartilage can be seen at the ends of the bones in the diagram.
   Describe the function of cartilage in the knee.

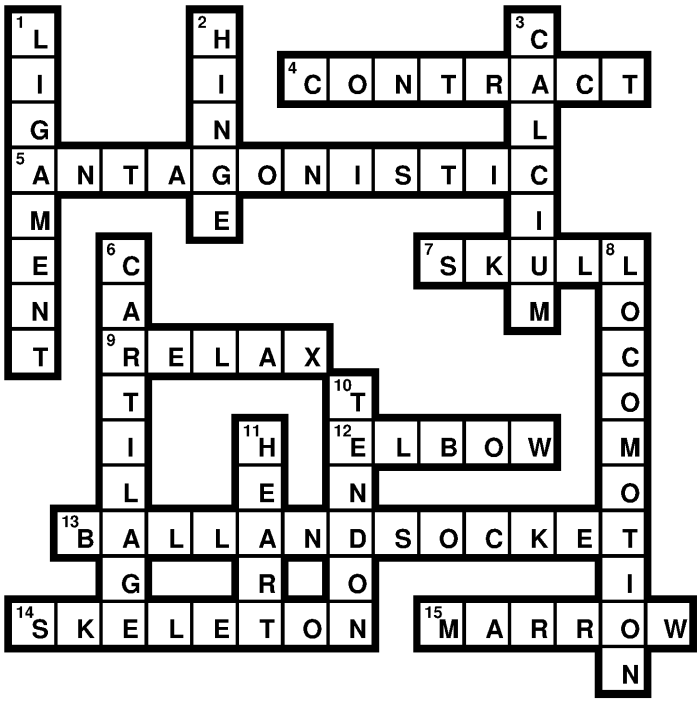
8. Explain how you can use points on a graph to evaluate the results of an inve

Answers

Comprehension questions

1. *three from:*
   - support
   - locomotion/movement
   - protection
   - making new blood cells or new bone cells
   - storing calcium / storing phosphate
2. marrow
3. (a) at the ends of the bones / where the bones meet
   (b) reduce friction / protect the ends of the bones / withstand compression
4. knees
   toes
   ankle
5. a ball and socket joint allows bending and rotation, while a hinge joint allows bendi
   movement in three dimensions for ball and socket and two dimensions for hinge)
6. (a) the arm bends (up)
   (b) the arm straightens
   (c) the arm straightens / the lower arm falls down
7. any example at a hinge or ball and socket joint with movements in opposite directio
   at the wrist: the hand moves up and down
   also accept movements of the eyes up/down or right/left
8. the upper strip – humerus bone
   the lower strip – radius and ulna bones
   the string attached to hole 1 – the triceps muscle
   the string attached to hole 3 – the biceps muscle
9. simple / easy to see / easy to make / has the same shape as the arm / has the same
   materials for bones / uses soft flexible materials for muscles, etc.
10. pieces of string do not contract or relax / lower arm has two bones and not just one
    the hand or point where we hold things / distances or size are/is not accurate, etc.
11. (a) mass
    (b) force
    (c) angle of supporting string / angle between upper and lower arm / position of l
12. the answer should describe their results but the trend should be 'the greater the m
    support it'
13. (a) the force needed to support a mass is (much) greater than its weight
    (b) because the muscle/string does not pull at the same point where the mass is s
        answers based on moments)
14. answers will vary but should refer to how good or bad the results are based upon h
    the graph, or how smooth the line is
15. answers will vary but should refer to any problems, such as keeping the upper part
    the lower part from bending; answers may also refer to differences between the mo
    suggestions should be made for improvements, such as use more than one clamp, u
    model the same size as a real arm, etc.

Crossword



End-of-topic questions

1. earthworm
2. *three from:*
   - movement (of body parts)
   - support
   - protection
   - locomotion (movement from one place to another)
   - making new blood/bone cells
   - storage of calcium/phosphate
3. people are born with a large number of bones / about 270 bones
   during growth, some of these bones join
   so the number of bones decreases with age
4. (a) marrow
   (b) making new blood cells / new bone cells
5. can repair itself
6. (a) place where bones meet
   (b) (i) hinge
   (ii) elbow (accept fingers)
   (c) (i) ball and socket
   (ii) shoulder (accept wrist)
   (d) (i) fixed
   (ii) in the skull/cranium/head
7. (a) For the knee to bend in the direction of the arrow, muscle **A** must contract and
   (b) antagonistic
   (c) (i) ligament
   (ii) holds the bones together
   (d) protection / to reduce friction
8. see how close the points are to the line or trend
   if the points / all points / most points are close to a line or trend, then the results ar
   if the points / many points / some points are far from a line or trend, then the resul