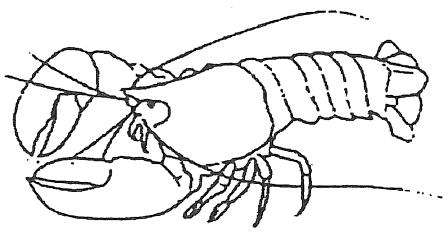
HUMAN BIOLOGICAL SCIENCE SERIES

Human Biological Science 1B

C. BOWDEN AND S. GILBERT

MARRON PUBLICATIONS



Introduction

This is the second unit of the Human Biological Sciences stage one course. Following on from unit 1A this unit provides a closer look at human cells and systems. You will study the role of genetics and the environment in determining individual characteristics and the use of structural characteristics in the classification of humans. You will continue your use of scientific methodology in scientific investigations and build on your understanding and of scientific terminology

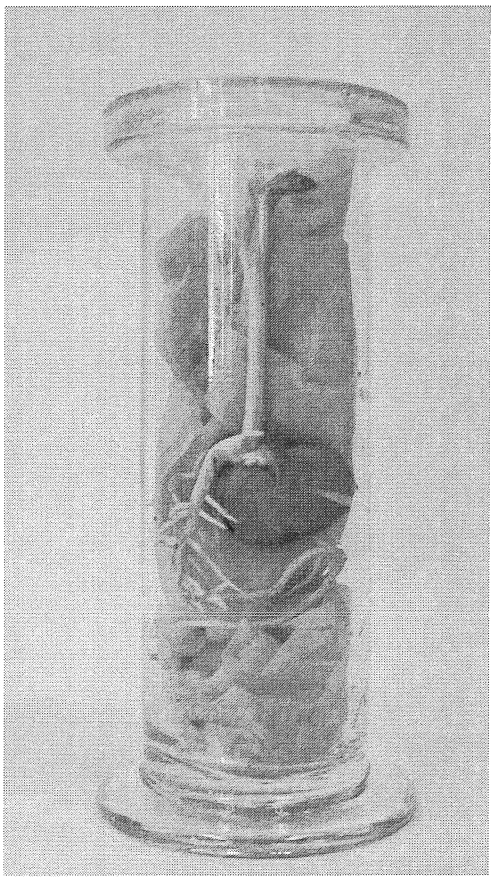
Measuring growth

Humans grow due to a process of cell division called mitosis. This growth occurs very slowly, making observations of growth difficult in the short term. However plants, especially beans grow relatively quickly. Once a seed has germinated its root and shoot/stem will develop and grow. In this activity you are going to make observations based on measurements of a germinating bean seed.

Aim – To make measurement observations of a germinating bean seed.

Materials

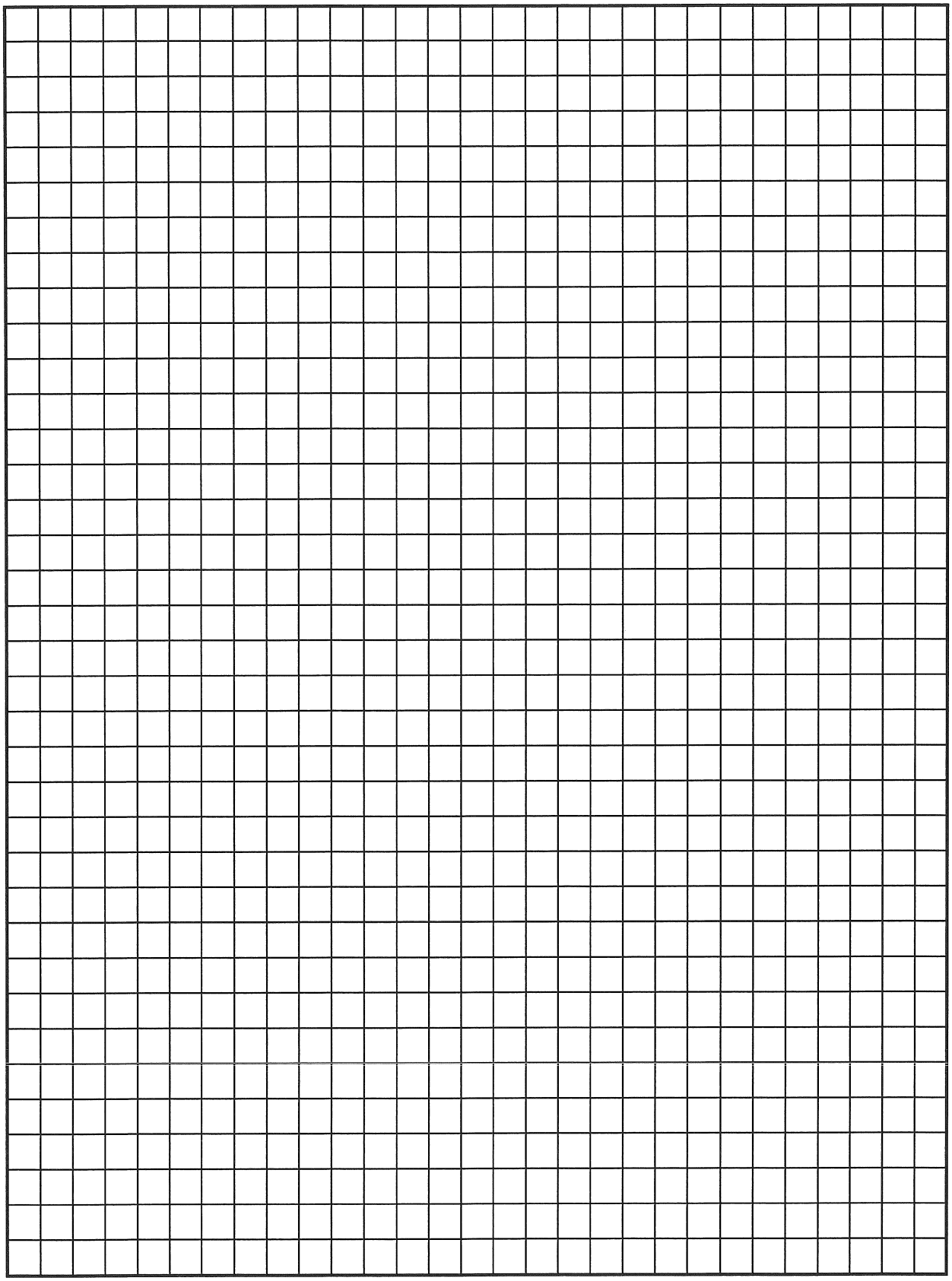
- 1 gas jar per 2/3 students
- Paper towel
- Water containing fungicide eg Mancozeb
- 3 bean seeds



Procedure

1) Make a 'tube' of paper towel and place in the gas jar, so that it fits against the inside of the gas jar.
2) Use small 'balls' of paper towel to pack the middle of the gas jar.
3) Moisten the paper in the gas jar with water containing fungicide.
4) Arrange the bean seeds between the glass jar and the paper towel; the seeds should be evenly spaced around the jar and each seed should be placed midway down the gas jar.
5) Keep the paper moistened and measure the length of the shoot and root each day and record in the table below.
6) Record any other observations eg seed coat, shape of stem and root, number of leaves etc.
7) Upon conclusion of the measuring, graph your data using a line graph on the grid provided.

Graph



Phases of mitosis

Teachers see Teachers Guide

Interphase

Interphase is the phase between the actual cell division; cells spend the majority of their time in interphase engaged in normal metabolic activity. A cell can be identified as being in interphase when its;

- _____
- _____
  _____
- _____
- _____

At the end of interphase when a cell is about to undergo the mitotic cycle the nucleus will duplicate each chromatin thread.

Prophase

Prophase is the first phase of the mitotic division. A cell can be identified as being in prophase when;

- _____
  _____
- _____
  _____
  _____
- _____
- _____

Metaphase

Metaphase is the second phase of the mitotic division. A cell can be identified as being in metaphase when;

- _____
- _____
  _____
- _____
  _____

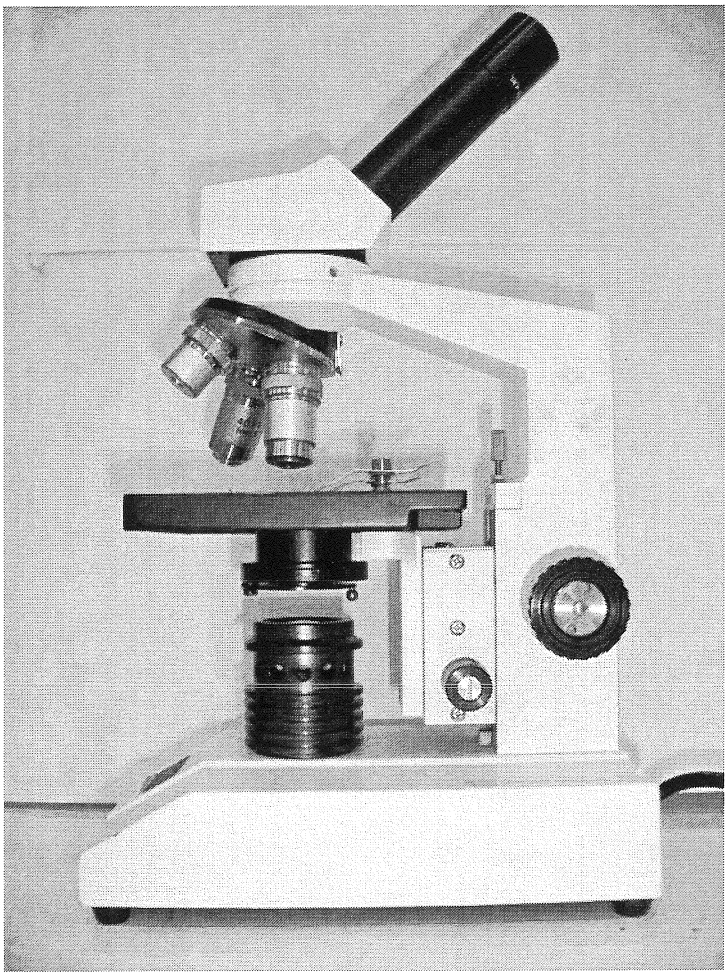
Online onion root tips

Use the internet to locate the following URL or search for 'The Biology project & Arizona University & Onion Root Tip'.
www.biology.arizona.edu/cell_bio/activities/cell_cycle/cell_cycle.html

Read through the first two pages, on the third page you find the table below;

	Interphase	Prophase	Metaphase	Anaphase	Telophase	Total
Number of cells						36
Percent of cells						100%

Follow the instructions and activities on the fourth and subsequent pages until you are able to complete the table.



Viewing living microscopic organisms

Aim – To view a range of different types of living microscopic organisms.

Materials

- Microscope and microscope lamp
- Cavity microscope slides & cover slips
- Pasteur pipette
- Cotton wool
- Pond water
- Living samples of a range of organisms; Amoeba, Euglena, Paramecium and Daphnia (not microscopic)

Procedure

1) On a glass slide place some filaments of cotton wool and on top of the cotton wool place a drop of liquid of one of the organisms. Then place a cover slip over the top of the liquid on the slide.
2) Place the slide on the stage and focus the microscope on low power. Once you have found some of the organisms move the slide so the organisms are in the centre of the field of view. Then focus on high power.
3) Draw your micro-organism in the space below remembering to follow the rules for a biological drawing (refer to your 2A booklet).

Name (magnification) _____

Cell division in onion root tips

Aim – To prepare a slide of a tip of an onion root and observe various stages of mitosis.

Materials

- Onion bulbs with growing root tips (pre-prepared)
- Commercial root tip slides (if available)
- Forceps
- Microscope slide and cover slip
- Pasteur pipette and 100mL beaker
- Paper towel
- Aceto-orsein stain
- Microscope

Procedure

1) Place 1-2 drops of aceto-orcein stain on a microscope slide.
2) Cut / pull off the final 3-5 mm of a root tip with the forceps and place in/on the drops of stain.
3) Place the cover slip over the root tip and a piece of paper towel over the cover slip.
4) Use your finger to gently push down on the paper towel / cover slip squashing the root tip, take care not to move the cover slip side ways.
5) Use the irrigation method (see your teacher if you unsure of the procedure) to add more stain to the slide.
6) Observe your slide under the microscope and identify cells at the various stages of mitosis. If no clear cells / stages are visible then repeat steps 1 to 5.

Results

Tick each of the boxes in the table below if you observe cells within that stage. Your teacher may ask you to focus on a cell at a particular stage so that they can check your accuracy.

Stage	Observed = ✓
Interphase	
Prophase	
Metaphase	
Anaphase	
Telophase	

An introduction to Stem Cells

Go to the website below to view the information sheet titled 'An introduction to Stem Cells' and use this to answer the following questions. *Teacher see Teachers Guide*
www.stemcellcentre.edu.au/resources.ashx/resourcelibrary/24/resourceFile/.../Fact_Sheet_1_-_Introduction_to_Stem_Cells.pdf

1. Approximately how many cells make up the human body?

2. What is meant when stem cells are described as 'unspecialised'?

3. What is the benefit of stem cells being capable of self-renewal?

4. List the four main types of stem cells currently being investigated.

5. In general what is the relationship between age of stem cells and ability to differentiate into different types of cells?

6. Distinguish between the terms pluripotent, multipotent and totipotent.

7. Explain using an example how stem cells can be used for 'cell-based therapies'.

8. How can research into stem cells be used to prevent animal testing?

Regulation of Body Temperature

Humans are termed 'homeotherms' that is we can maintain a fairly constant body temperature independent of the external temperature in most environments. Humans have a 'thermostat' within the brain that measures the temperature of the blood and attempts to maintain it around 37° Celsius. This is known as the core temperature, other parts of the body especially the extremities can be at a higher or lower temperature for short periods of time.

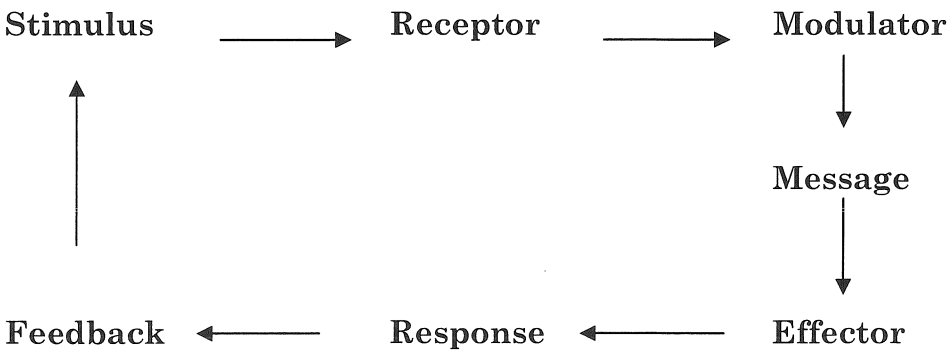
The advantage of a constant body temperature is that the metabolic chemical reactions that occur in our cells can be tailored to work at their optimum rate. This is done by producing enzymes that assist the reactions by working at their best when the surrounding temperature is 37° C.

The disadvantage of being a homeotherm with a constant body temperature is that problems occur when that temperature is not maintained. Too high or low temperatures can result in the denaturation of enzymes, nerve malfunction and even death.
As a general rule the body can only survive for a short period of time if the core temperature gets too high or low. A 5 degree increase or decrease can lead to brain damage and a 7 degree differential can result in death.

The stimulus response model

Homeostasis is the name given to the concept of maintaining a constant optimal environment irrespective of the external one.
Control mechanisms function at the level of cells, physiological systems and behaviour, and compensate for changes in the external or internal environment. To maintain homeostasis the body requires control mechanisms that operate automatically. These mechanisms usually occur as steady state models.

Steady state models are usually presented as follows.



The stimulus is the factor that changes and causes the system to operate, the receptor detects the change in the stimulus; the modulator processes information from the receptor and sends an electrical (nervous) or chemical (hormonal) message to the effector. The effector carries out the response, the response is the change in the effector to maintain homeostasis and the feedback is how the response modifies the stimulus.

Use the information above to complete the following stimulus response model below.
Teachers see Teachers Guide

Notes

Preventing body temperature from decreasing

Stimulus → **Receptor** → **Modulator**

_____ _____ _____

↑ ↓

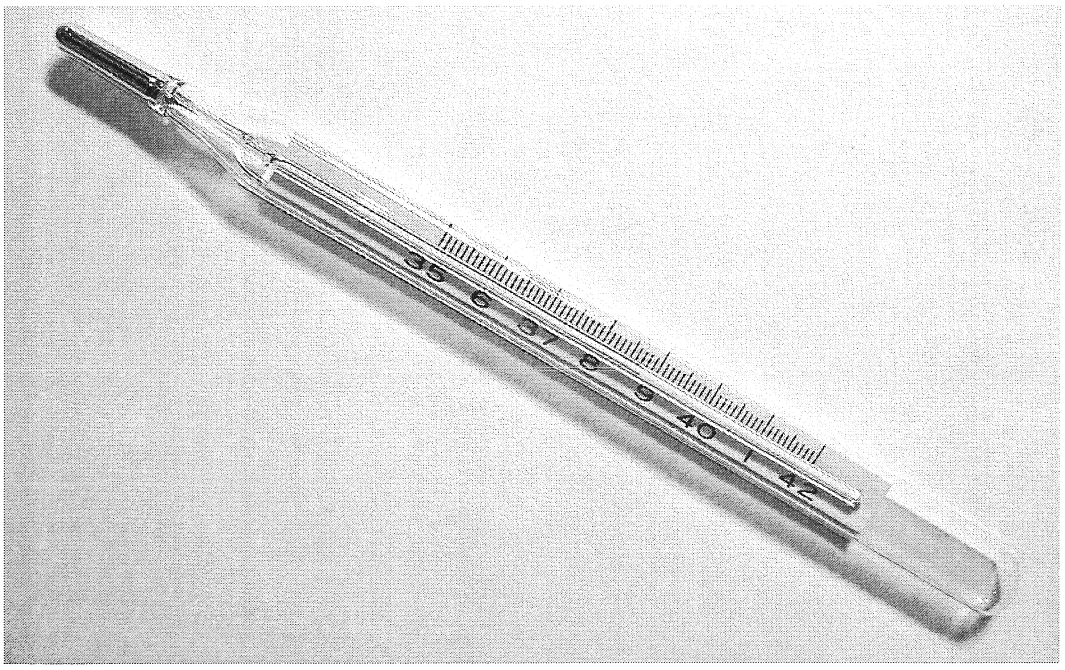
Message

_____

↓

Feedback ← **Response** ← **Effector**

_____ _____ _____
_____ _____ _____
_____ _____ _____
_____ _____ _____
_____ _____
_____



A clinical thermometer

Library research – dysfunctions

Research and report on the cause, symptoms, effect on the body and treatment for the following dysfunctions. The table has been provided for note taking.

Dysfunctions	Cause	Symptoms	Effect on the body	Treatment
Heat cramp				
Heat stroke				
Heat exhaustion				
Hypothermia				
Chilblains				
Frostbite				

Results

Time	Temperature after application of	
(min:sec)	Cold pack	Hot pack
Initial/normal		
1:00		
1:30		
2:00		
2:30		
3:00		
3:30		
4:00		
4:30		
5:00		
5:30		
6:00		
6:30		
7:00		

Data analysis

Draw a graph of your data on the grid on the following page, break the axis (if required) and use a scale to suit the data.

Questions

1. Examine the data and graph; did the skin temperature return to normal faster after being cooled or being heated?

   _____

2. Explain some possible reasons for the difference.

   _____

   _____

3. Compare your results to others in the class, did all subjects respond the same way?

   _____

4. Do you think you would respond in the same way in all areas of your body eg behind your knee?

   _____

5. How could this experiment be improved to make the data more reliable and valid?

   _____

   _____

   _____

Body temperature over 24 hours

A circadian rhythm is the sequence of events that occur over a 24 hour cycle in particular physiological processes of living organisms. The term 'circadian' comes from the Latin *circa* (around) and *dias*, (day) and literally means 'around a day'.

Most people have a biological clock that reminds them when it is time to eat, sleep etc; it also varies your energy levels. A good example of differences in people's circadian rhythms is the different between daytime people who like to go to bed early and get up early and night time people who like to stay up late and get up late. There are also differences between people with regards to exercise, some people like to exercise in the morning, others prefer the evening.

One of the circadian rhythms relates to body temperature. For the majority of people their body temperature will be higher in the late afternoon than in the morning.

It is reasonably easy to track the circadian rhythm of your body temperature. You just require a medical thermometer and some organisation.

Aim – To determine if you have a circadian rhythm to your body temperature.

Materials

- Thermometer (medical)

Procedure

1) Use your thermometer to take readings every 1, 2 or 3 hours while you are awake, it doesn't matter when you take readings or if you miss some as this is an extended investigation and should continue for between 3 and 7 days and even longer if possible. Don't exercise, eat or drink anything right before you take your temperature.
2) Make sure to take your temperature and read the thermometer the same way every time.
3) Construct a results table and record your temperature and the time to the nearest hour each time you make a measurement.
4) At the end of your measurement period, graph your results using the x-axis for the time of day and the y-axis for your body temperature. Note – use the grid in landscape orientation, with one division = 3 hours.

Results

Body temperature and the environment

This focus of this activity is to provide you with an opportunity to develop your experimental design skills. You will be given the outline of an experiment and some suggestions. But how you design and conduct your experiment, analyse the data and report your findings is up to you (in consultation with your teacher).

Task

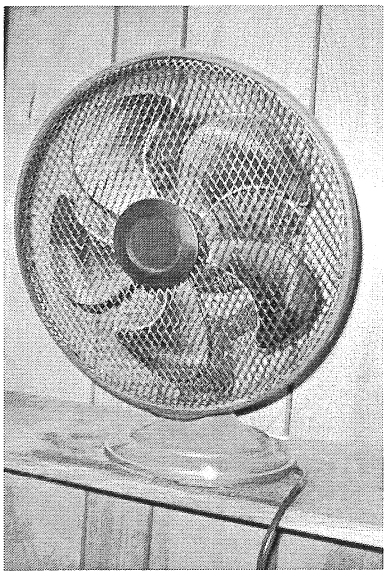
A group of students wanted to investigate if a short term change in environmental conditions affected body temperature.

Experimental outline

The class can be divided into groups, each group is subjected to a different environmental condition for a set period of time and then their temperature is recorded.

Suggestions for environmental conditions

- Hot eg in front of a heater, warm clothing, warm shower
- Cold eg in cool room i.e. canteen, wet clothing, minimal clothing, cool shower
- Wind eg outside/fan vs still air
- Dry vs submerged in water eg swimming pool
- Spaced apart vs huddled together



Suggestions for experimental design

- Have a control
- Pre/initial measurements
- Replication/sample size
- Averaging
- Random selection of group composition
- Controlled variables

Planning space for procedure and experimental results.

Body systems

When looking at the structural organisation of the human body we have spent time studying the cell and how it functions. As mentioned earlier, cells make up tissues and tissues combine to produce organs. Some organs work together to produce systems and a large proportion of time in human biology is devoted to studying the bodies systems. The human body is made up of many systems and these systems operate together to enable the human body to function efficiently. Some of the more well known body systems include the circulatory, muscular and skeletal as the have easily identifiable structures. While others like the immune and endocrine are less obvious and their role may not be as clearly defined.

In unit 2A you wrote notes on the major systems of the body. Write as much information as you can recall about each system in the spaces below eg the main organs/tissues which makes it up and the role that it plays in the functioning of the body. *Teachers see Teachers Guide*

Circulatory

Muscular

Digestive

Respiratory

Skeletal

Body systems

As mentioned the human body is made up of a number of systems and these systems co-ordinate their responses to produce a functioning organism. Over the next few weeks you are going to be looking at the skeletal and muscular systems in detail. Write down a paragraph on what you know about these two systems. Some of the questions that you might like to focus on are listed below.

- What organs/structures make up the system?
- What are the functions of the system?
- How does the system help the human body to function?

Skeletal system

Muscular system

The skeletal system

Humans are classified as vertebrates due mainly to the structure and location of their skeleton. The human skeleton is termed an endoskeleton, meaning that it is located inside the body and consists of over 200 bones. The number of bones varies through time, as some bones fuse together at different stages in the human's life cycle. Bones in the human skeleton have a large amount of calcium which helps to give them strength. A vertebral column also runs down the back of the skeleton helping man maintain an erect posture and also providing a passageway for a nerve cord which runs from the brain down the body. The skeleton has many functions.

Functions of the skeletal system *Teachers see Teachers Guide*

Support

Movement

Protection

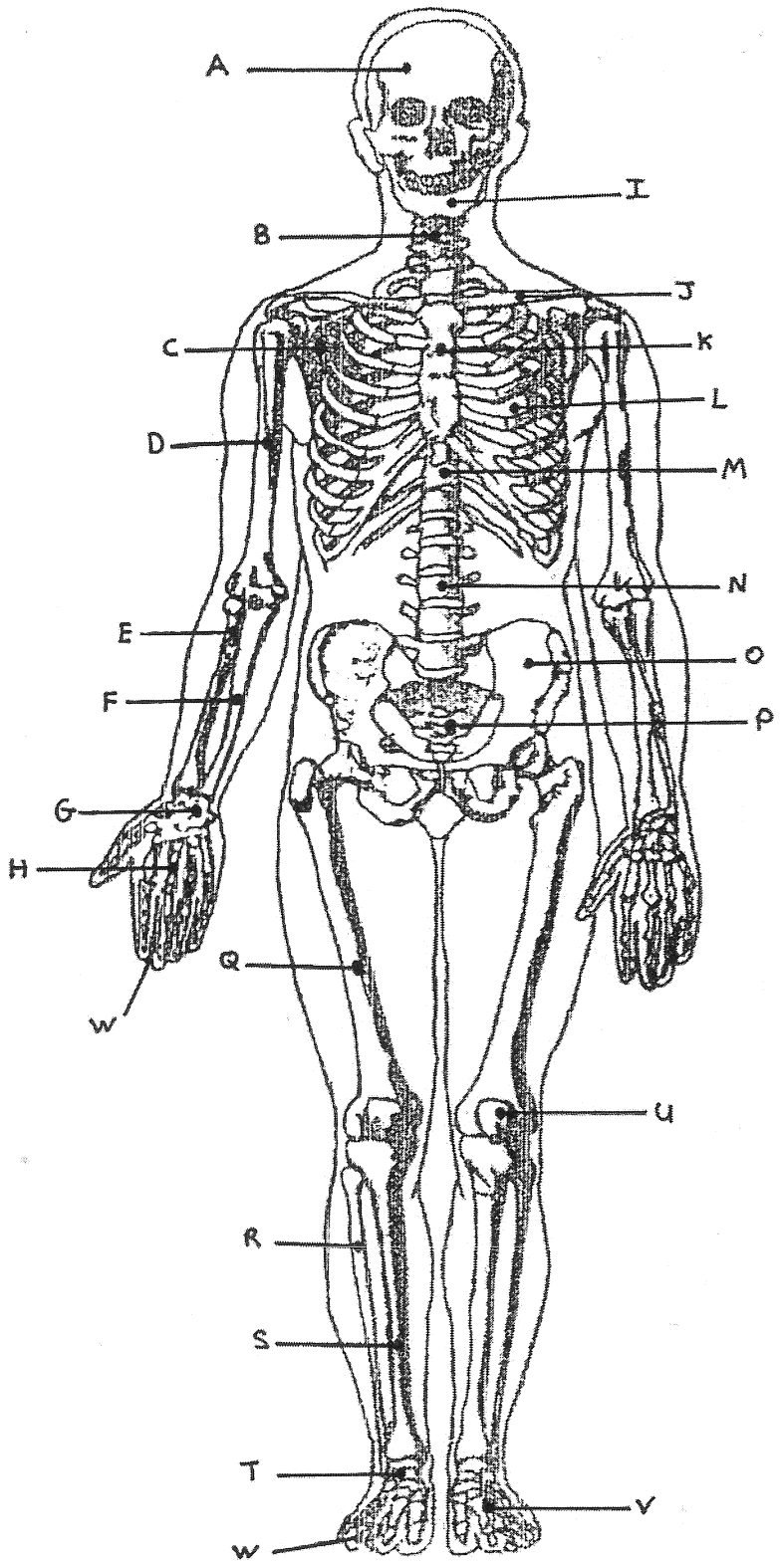
Storage

Production

Tissues of the skeletal system

The skeleton diagram

Use the table from the previous page and the help of your teacher to label the following diagram of a human skeleton.
If possible, your teacher will show you a skeleton model that you can identify each of these bones on.



8. If you look at the bones in the wrist and hand (carpals, metacarpals and phalanges) you will notice that most of them are small, what would be the advantage of this?

9. What is the advantage of having the two bones (radius and ulna) in the forearm?

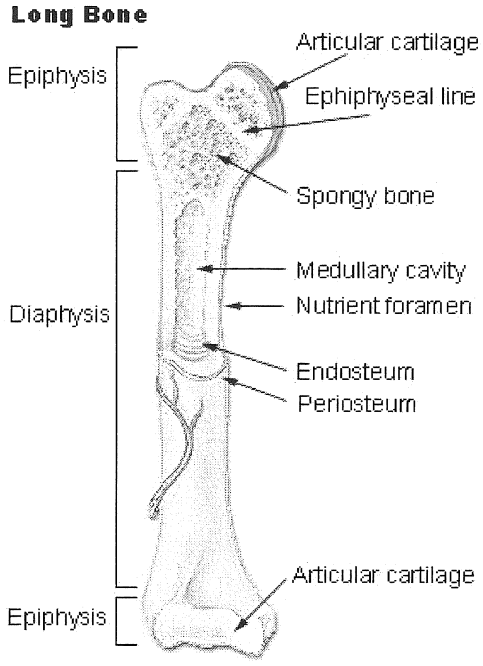
10. Describe the femur and relate this description to its function.

11. Look at the bones in the feet and compare them to the wrist, what do you notice and how may this suit the function of the foot?

12. Describe the general shape of the ribs and relate this to their function.

Structure of bone – diagram

Add labels to the diagram below for 'compact bone' and 'nutrient artery.



Long bone dissection

Aim – To identify the parts of a long bone.

Materials

- Long bone from butchers (Longitudinal section)
- Gloves
- Probe
- Newspaper
- Hand lens

Procedure

1) Study the bone and use the previous notes and diagram to identify the various parts.
2) Answer the following questions.

Questions

1. Describe the 'feel' of the external surface of the bone on the diaphysis. What is the name of the membrane that covers the diaphysis and what is its function?

How strong are hollow bones?

Aim – The purpose of this activity is to see if hollow bones have greater strength than solid bones of the same weight.

Materials

- Beam supports (eg, tables, chairs)
- 2 litre plastic cool drink or milk container that can be attached and suspended below the beam with string
- Plastic funnel
- Measuring cylinder
- 6 pieces of A4 paper (same size and thickness as this page)
- Sticky tape and string
- Water (to use as weight)

Procedure (Read through all the points in the procedure before you begin)

1) Roll up one of the pieces of A4 paper (Landscape orientation) to form a hollow cylinder with a diameter of 2 cm. Use small pieces of sticky tape to stop it unravelling (This represents a hollow bone).
2) Fold the second piece of A4 paper into a solid beam by folding it in half along its longitudinal length, and then fold it again into quarters along its longitudinal length and so on until it is about 2 cm wide. Use small pieces of sticky tape to stop it unravelling (This represents a solid bone).
3) Arrange two supports (eg, tables, chairs) with a gap between them of about 20 cm.
4) Place the 'solid' paper beam across the gap.
5) Suspend the plastic bottle and funnel below the centre of the beam with the string.
6) Use a beaker to add water slowly to the bottle until the beam bends and falls.
7) Measure the amount of water that was added to the bottle by pouring it into the measuring cylinder.
8) Record this result in the results table. Repeat steps (4) to (7) for the 'hollow' paper beam.
9) Weigh the empty container using an electronic balance.
10) Calculate the weight that was required to make each beam 'fail'.
    Note - 1 litre of water weighs 1 kilogram and 1 mL weighs 1 gram.
11) Repeat all parts of the procedure (1) through (10), three more times making a total of three trials and then calculate the averages.

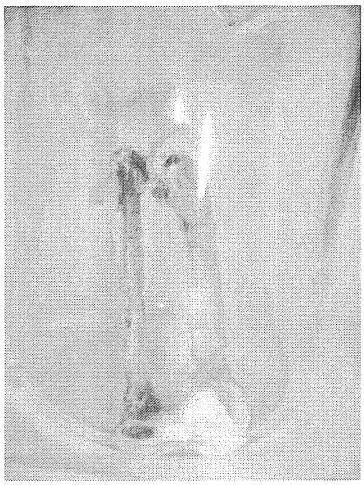
Results

Beam	Trial	Amount of water held (L)	Weight of container (g)	Combined weight of water + container (g)
Solid	1			
Solid	2			
Solid	3			
Solid	**Average**			
Hollow	1			
Hollow	2			
Hollow	3			
Hollow	**Average**			

Rubber bones

What makes bones strong? Drinking milk is supposed to help, as it is high in calcium. Calcium is a metal, and in bones it is joined with carbonate to form calcium carbonate. The calcium carbonate makes the 'soft' cartilage of bone hard. How much of a bone is calcium carbonate?

Aim – To determine if the presence of calcium carbonate is responsible for the hardness of bone



Materials

- Two 250 mL beakers
- 200 mL of 1M HCl and 200 mL of distilled water
- Forceps and scalpel
- Two raw chicken long bones (leg bones are best)

Procedure

1) Use the scalpel to remove the meat from both of the bones.
2) Place each of the chicken bones into a separate beaker.
3) Pour the acid into one of the beaker so that it covers the bone.
4) Pour the distilled water into the other beaker so that it covers the bone.
5) Leave both beakers in a cool place for 24-48 hours.
6) Remove the bones with the forceps and rinse in tap water.
7) Compare the ease of bending and brittleness of the bones.
8) Describe and explain your observations below.

Observations

Joints – notes *Teachers see Teachers Guide*

Types of joints

Immovable joints

Immovable joints as the name suggests are joints between bones that do not allow any movement. The bones are connected by a fibrous connective tissue. The best examples in the body are the joints between the bones that make up the skull or cranium. These are called sutures.

Slightly movable joints

Again as the name suggests these joints allow only limited movement between the bones. The bones are joined by a flexible but strong cartilage. Examples of slightly movable joints in the body include the joins between the ribs and the sternum, and the joins between the vertebrae.

Freely moveable (Synovial) joints

Freely movable joints are more commonly known by their structural name, synovial joints. The bones are held together by a collection of ligaments and cartilage, which along with the associated muscle and bone of the joint, allows the bones to move freely against each other, or in scientific terminology, to 'articulate'.
Synovial joints are what allow us, along with our muscles, to move our body. Due to their importance they can be further divided up into four subtypes (Hinge, Ball and Socket, Gliding and Pivot)

Notes *Teachers see Teachers Guide*

Articular Capsule

Synovial membrane

Synovial fluid

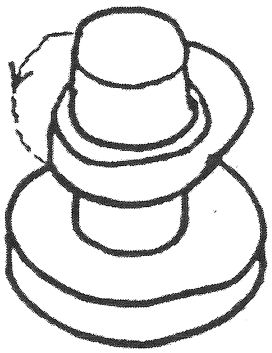
Articular cartilage

Bursae

Accessory ligaments

Pivot

Pivot joints allow rotational movements eg head moving back and forth when indicating 'no'.
The first and second vertebra has a pivot joint between them as does the radius and ulna in the forearm, allowing the rotational movement of operating a door handle.



Complete the following table to summarise the types of synovial joints.

Type	Description	Range of Movement	Examples

Flexibility

Many activities require lots of twisting and stretching. These movements can be carried out more easily if your muscles can stretch, and your joints move freely.

Flexibility is the ability of a joint either by it self or in conjunction with other joints to move through a full range of motion without causing pain or injury.

You have probably noticed that some people such as gymnasts and dancers can move their bodies much more freely and easily than others. One of the reasons for this is that their joints are more movable or flexible.

Try the following test to find out how flexible your knee joint is.
1) Stand with your feet together and bend your knees to a 90 degree angle.
2) Keeping your knees bent, bend over and touch the floor with the tips of your fingers.
3) Keeping your fingers on the floor, straighten your legs.

1. Describe what you felt as you straightened your legs.

_____

_____

_____

_____

If you had trouble or discomfort while straightening your knee joints it was because the tendons and muscles that surround the joint are not very stretchable. Regular exercise and stretching movements can lead to an increase in 'stretchability' of the muscles and tendons thus making joints more flexible.

2. List three activities that require good flexibility.

a) _____

b) _____

c) _____

3 If you were more flexible, what type of movements would you be better at?

_____

_____

Good flexibility is important for all active people. Good flexibility doesn't just allow you to move more easily, it also decrease's the chance of you injuring a joint while performing that movement.

How flexible are you?

There is no single test that gives you a score for overall flexibility. Different tests are specific to a particular movement or joints. In this activity you will perform three tests. The first is norm referenced (Performance is compared to a standardised control group) and a comparison or rating can be attained, the other two are not able to be norm referenced as there are too many variables that can affect the result.
This activity involves collecting and analysing the data.

Aim – To collect and analyse data on the flexibility of class members.

Materials
- Two 1 metre rules
- Sticky tape
- Wall
- Science bench/sturdy stool (make sure equipment is sturdy and in good condition)

Teacher Note – Students should be supervised while standing on stools/benches.

Toe touch test (flexibility of the lower back and hamstrings)

Procedure
1) Tape the 1 metre rule to the side of the Science bench so that the 50 cm mark is level with the top of the bench.
2) Stand on top of the bench (with your shoes off), with your toes just on the edge of the bench near the rule.
3) Bend slowly downward as far as possible, reaching with the extended fingers of both hands as far as possible. **Note – your knees must remain straight and make sure you don't overbalance and fall off the chair/bench.**
4) Have your partner read the furthest point that your fingers can reach on the ruler.
5) Use the 50 cm marking as a zero point, above the zero point is measured as negative and below the zero point as positive.
6) Measure your maximum distance in centimetres (from the zero point).
7) Use the rating scale table below to determine your rating.
8) Record your rating for flexibility of the lower back/hamstrings in the results table.

Toe touch test flexibility rating scale
Teachers see Teachers Guide

Female (cm)	Male (cm)	Rating Number	Rating Term

Analysing the data

Your teacher will organise for you to record the class results.

1. Calculate the average rating for the lower back and hamstring flexibility.

2. How did your result compare to the average? Give some reasons for you having your particular rating.

3. Calculate the average male and female rating for the lower back and hamstring flexibility.

4. Calculate the average rating for the calf muscle flexibility.

5. How did your result compare to the average? Give some reasons for you having your particular rating.

6. Calculate the average male and female rating for the calf muscle flexibility.

7. Calculate the average rating for the shoulder joint flexibility.

8. How did you compare to the average? Give some reasons for you having your particular rating.

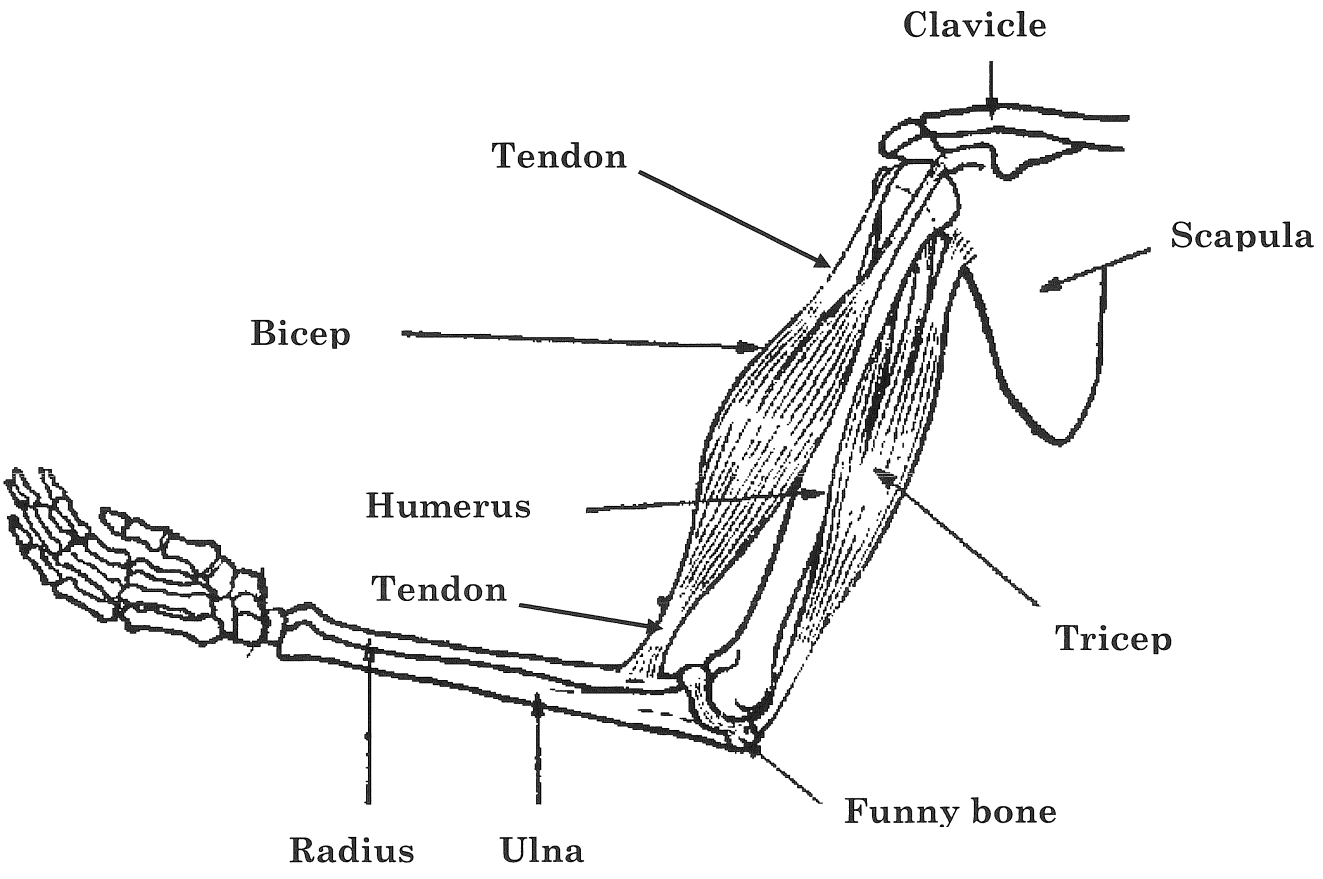
9. Looking at the results was there a general difference between the flexibility of males and females? Explain.

Action of skeletal muscles

Notes

Teachers see Teachers Guide

- _____
- _____
- _____
- _____
  _____
- _____
  _____
  _____
  _____



Model of the action of Muscles

Both muscles and bones are required for moment of the body. It's the muscles that cause the movement and the bones that provide the structural support. At the conclusion of this activity you may need to hand in your model to your teacher.

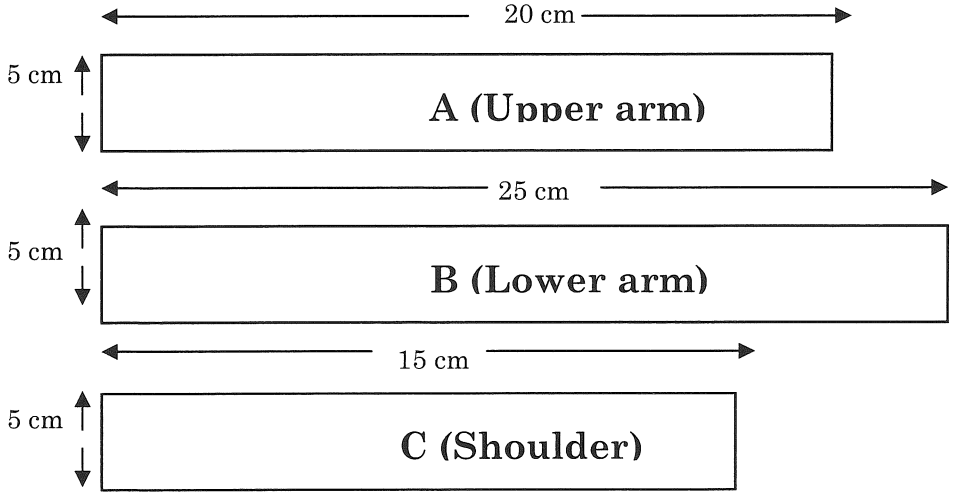
Aim – To see how muscles and bones work together using a simplified model of an arm.

Materials

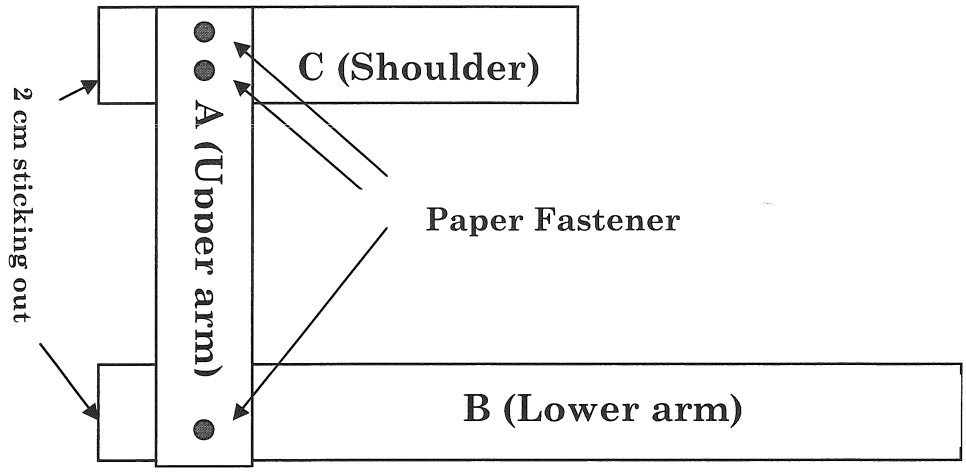
- Ruler
- Two pieces of string 40cm long
- Stiff cardboard at least 25cm by 15cm
- Scissors
- 3 paper fasteners

Procedure

1) Cut out three strips of cardboard and label them as per the diagram.



2) Place strip A on the top of strips B and C, leaving at least 2cm of strips A and B sticking out on the left. Use the three paper fasteners to fasten the strips together as shown.



3. What happened to the length of String B (between the holes) when you pulled String A?

4. What happened to the length of String A (between the holes) when you pulled String B?

5. What happened to the length of String B (between the holes) when you pulled String B?

6. Like the strings in the model, muscles work in pairs. As muscles are attached to bones by tendons, when one muscle contracts and shortens it pulls the bones towards it, this stretches out the other relaxed muscle. What modifications could be made to improve your model, in its illustration of how antagonistic muscle pairs work?

6) Describe the appearance and functions of these tissues.

Muscle

Fat

Skin

7) Follow one of the large muscles down to where it meets the bone, you may notice a shiny white tissue.

8) What is the name and function of this tissue?

9) Use your scalpel to cut the muscle down to the bone and then cut along to the joint. Remove as much tissue as possible from around the joint. The joint should contain cartilage and ligaments, see if you can find these (you may need to separate the joint).

10) What to you think the function of the cartilage would be and what suits it to its function?

11) What is the function of ligaments?

12) Clean and neatly return all equipment.

Did you know?
The feathers of a chicken are actually a modified fish scale!

Muscle fibres

Most people know that muscles are made up of fibres. But did you know that there are different types of muscle fibres. Muscles are made up of slow twitch and fast twitch fibres.

Fast twitch fibres can deliver extreme amounts of power for short periods of time, while on the other hand; slow twitch fibres provide endurance, delivering prolonged strength of contraction over much longer periods of time.

Everyone has different percentages of slow and fast twitch fibres and the differences between fast and slow twitch fibres are outlined below.

a) Fast twitch fibres are about two times as large in diameter as slow twitch fibres.

b) The enzymes (substances that speed up chemical reactions in the body) that promote rapid release of energy for the muscle are two to three times as abundant in fast twitch fibres as in slow twitch fibres. This makes the maximum power that can be achieved by fast twitch fibres up to two times that of slow twitch fibres.

c) Slow twitch fibres are mainly for endurance (like long distance running), especially for producing energy using oxygen in the muscle. They contain considerably more myoglobin (a haemoglobin-like protein that combines with oxygen within the muscle fibre), which increases the rate of movement of oxygen into a slow twitch fibre thus making more oxygen available to it.

d) The number of capillaries supplying slow twitch fibres is greater than those supplying fast twitch fibres.

It can be concluded that slow twitch muscle fibres obtain most of their energy from aerobic (with oxygen) energy sources and are beneficial for endurance type events. Fast twitch fibres obtain most of their energy from anaerobic (without oxygen) energy sources and are beneficial for power type events.

We know what the different fibres are used for but how can we work out what type of fibre we contain in our own muscles?

The type of fibres you have firstly depends on the kinds of muscle fibres that you have inherited from your parents and secondly those you have developed due to the kinds of activities that you normally participate in. For instance, those of you who play basketball probably have a high percentage of slow twitch fibres to allow for extended use of your muscles but also enough fast twitch fibres to allow you to move quickly and powerfully to make the big score of the game. On the other hand, those of you who are sprinters probably have a lower percentage of slow twitch and more fast twitch fibres to allow for the quick bursts of power it takes to run fast over a short distance.

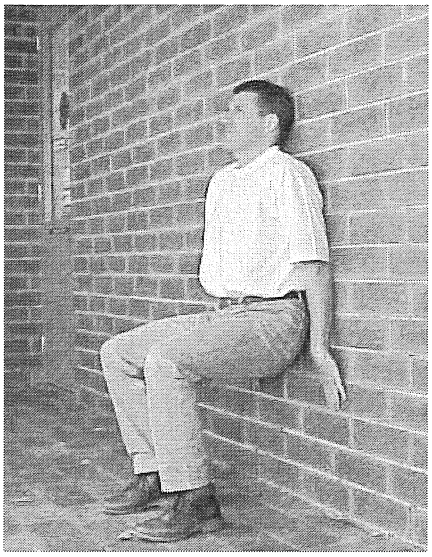
So what types of fibres do you have?

This activity will give you a general idea of the types of fibres that make up your thigh muscle (quadriceps) by testing its endurance. The longer you can hold the contraction of the quadriceps the more likely that you have a high percentage of slow twitch fibres. If a student cannot hold the position for very long, it is more likely that this student has a higher percentage of fast twitch fibres. Before the activity is started, think about what kinds of activities or sports each student is normally involved with eg sports that involve strength and short bursts of speed or sports that involve stamina and endurance. Try to predict who would be more likely to withstand the activity the longest. These predictions can be placed in your results table if desired.

Aim – To determine the ratio of fast and slow twitch muscles in the quadriceps.

Materials

- Stopwatch
- Brick wall



Procedure

1) Read through all of this activity before you start, as failure to do so could lead to invalid results.
2) Write down every class member's name in the results table.
3) Next to each name indicate if they consider themselves better at strength/speed or stamina/endurance type sporting activities.
4) Predict which students you think will be able to hold the contraction the longest.
5) Form small groups (2 – 3 students).
6) One student should stand with their back facing a flat wall.
7) While the back is still touching the wall, lower yourself into a partial sitting position. At this point, your thighs should be parallel to the floor and your back should be flat against the wall (see diagram).
8) Start the stopwatch and time how long this sitting position can be maintained. Each person should try to hold the position as long as possible, but stop when you cannot tolerate the 'burning sensation' felt in your thighs.
9) Once you reach a point where you cannot continue, record the time in seconds and have two students ready to pull you forward to relieve the contraction
10) Repeat this exercise for each student.
11) Collect class results.
12) Analyse results with the help of the table on the following pages and answer the questions.

Questions

1. The students who were able to last longer during this exercise, did they also participate in sports or other physical activities that require greater endurance? Explain.

   _____

   _____

2. Did it appear that students who were not able to last very long during this exercise are those who normally participate in activities that require bursts of power? Explain.

   _____

   _____

3. What other factors could account for their low times? Explain.

   _____

   _____

4. How did the results for the girls compare to the boys?

   _____

   _____

5. How could this test be improved?

   _____

   _____

6. How did you go in the test? Were you surprised with your result, compared to the rest of the class?

   _____

   _____

Analysing the data

- less than 60 seconds, the student probably has more fast twitch muscle fibres in their upper leg or unfit eg no sport/activity.
- more than 60 seconds but less than 90 seconds, the student probably has at least half of slow twitch muscle fibres in their upper leg (the closer the student comes to reaching one minute, the higher percentage of slow twitch fibres).
- more than 90 seconds indicates that the student's upper leg consists primarily of slow twitch muscle fibres.

Note – These figures may vary slightly due to different levels of fitness.

The table below gives some data on muscle fibre type obtained from studying elite athletes. *Teachers see Teachers Guide*

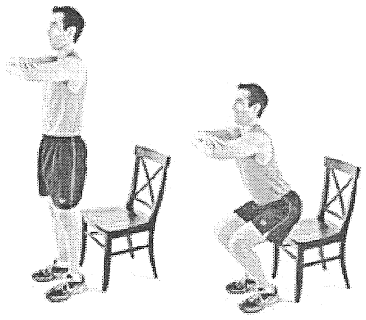
Sport	% of slow twitch fibres	% of fast twitch fibres
	80	20
	75	25
	60	40
	50	50
	35	65
	30	70
	8	92

Cardiovascular endurance

Cardiovascular endurance can be measured in a number of ways, while no one test can be used to give a very precise assessment, by completing a range of tests you should be able to obtain a fairly valid rating of your level of cardiovascular endurance. The test you will complete in this section should be able to give you an idea of your rating but you would need to see a sports physiologist for a valid assessment.

Squat test

Aim – To determine your endurance level by recording the number of squats you can do.



Jorge Cruise

Procedure

1) Find a chair where when you squat/sit on it your knees will be at right angles.
2) Stand in front of a chair or bench with your feet a shoulder width apart, facing away from it.
3) Squat/sit down and lightly touch the chair before standing back up. Continue this action at a rate around 1 squat per second.
4) Keep doing this until you're fatigued (unable to continue), counting how many squats you can do. Stop if you are able to complete more than 90 squats.
5) Record the number completed in the results section and use the table provided to determine a rating of your endurance level.

Results

My number of squats completed was - _____

My endurance rating for the squat test is - _____

Endurance ratings for squat test

Teachers see Teachers Guide

Gender	Male	Female
Age		
Excellent		
Good		
Above average		
Average		
Below Average		
Poor		
Very Poor		

How to read the chart
The numbers on the information chart correspond to how many kilojoules individuals of various weights burn per minute during different activities.

Simply multiply this number by how many minutes you perform a given activity.
Use the result table below to record the type and duration of the physical activity you complete in a typical week, then use the information chart to determine the number of joules you use up exercising.

For example, a 55 kg person jogging will burn about 38.9 joules per minute, or 1167 joules during a 30-minute jog.

My exercise routine
Write down the type and amount of exercise you would compete in a typical day or week and then determine your total energy expenditure.

Type of exercise	Duration (min)	Energy used (Joules/min)	Total (Joules)

Calculating a suitable 'level' of exercise

Now that you know the target range for your heart rate during exercise you need to determine the intensity of exercise you require to get your heart rate up to this level. This activity involves a step by step progression in intensity of a set exercise. Your partner will be measuring 1 minute intervals, during this time period you will need to complete a set amount of star jumps and then count your pulse to determine your heart rate.

Aim – To determine the number of star jumps that have to be completed in 1 minute to raise your heart rate into the exercise target zone.

Materials
- Stopwatch
- Partner

Procedure
1) Practise some star jumps making sure that you 'clap' your hand at the start/finish.
2) With your partner determine the time allocated for 1 star jump for each of the exercise routines in the results table, eg if you complete 10 star jumps in 1 minute you would be clapping every six seconds. Record your calculations in the results table.
3) Once you are ready, your partner should start the stop watch and you should start completing the star jumps, your partner should be looking at the watch and listening for the claps and giving you instructions to speed up or slow down as the case may be.
4) At the conclusion of 1 minute you should sit down and your partner should reset the stopwatch and time you for 15 seconds as you count your pulse.
5) Record this in the results table and move onto the next level of intensity.
6) Continue until you get to a level where you have reached your exercise target zone.
7) Once you have reached this zone you will have an idea of the type of intensity you will need to exercise at to increase your cardiovascular fitness.

Results

Number of star jumps per minute	Number of seconds for one star jump	Number of pulses in 15 secs	Heart rate (bpm)
10	6		
20			
30			
40			
50			
60			

Questions

1. How many star jumps did you need to do per minute to reach your exercise target zone?

   _____

2. How would the number per minute change as your fitness level increased? Explain

   _____

   _____

   _____

How performance-enhancing drugs work

Regularly we hear about athletes using or being tested for performance enhancing drugs. The practice of using artificial substances or methods to enhance athletic performance is commonly called 'doping'. There are heavy penalties for athletes, coaches and sport administrators who use, or condone the use of drugs. However athletes face enormous pressure to excel in competition, winning can reap them not only a gold medal but also a lot of money and fame.

Athletes know that training is the best path to victory, but they are sometimes willing to risk their health and athletic careers by utilising drugs and other practices to boost their efforts and give them an advantage over their competitors.

Athletes have a number of reasons for using performance-enhancing drugs. These may include;
- Build muscle mass and strength
- Increase the amount of oxygen available to exercising muscle
- Mask or deaden pain
- Stimulate the body to increase alertness and or aggressiveness and reduce fatigue
- Relaxation in general and for specific activities eg sports shooting
- Reduce weight
- Mask their use of other drugs.

Complete the table below and the research assignment that follows.
Teachers see Teachers Guide

Category	Drug names
	• Anabolic Steroids (testosterone, dihydrotestosterone, androstenedione (Andro), dehydroepiandrosterone (DHEA), nandrolone) • Beta-2 Agonists (clenbuterol, tertbutaline, salbutamol (Ventolin), fenoterol, bambuterol)
	• Protein hormones eg EPO • Artificial oxygen carriers • Blood doping
	• Narcotics(morphine, methadone and heroin)
	• Caffeine • Amphetamines • Ephedrine
	• Alcohol • Beta-blockers • Cannabinoids (marijuana)
	• Furosemide • Acetazolamide
	• Epitestosterone • Plasma expanders (Albumex, Gelofusine and Haemaccel.) • Secretion inhibitors(probenecid, sulfinpyrazone)

The history of drug use in sport

Use the internet to go to the URL below and answer the questions that follow.
http://www.ausport.gov.au/fulltext/2001/asda/drugsinsporthistory.asp
Teachers see Teachers Guide

Introduction

1. Where did the word 'dope' originate from?

_____

_____

2. What does the word, doping, mean in today's sporting context?

_____

_____

Early games

3. What did the Greeks believe was an important nature of 'athletics'?

_____

_____

4. List three ways that sport from 400BC was similar to that of today?

_____

_____

_____

Roman period

5. List two examples of where the use of drugs during the Roman period occurred.

_____

_____

Christian era

6. Describe the "ethos" used during the Christian era to discourage the popularity of sport.

_____

_____

Sport in the early nineteenth century

7. List three "sports" from the early nineteenth century that would not be considered true sports in our current century.

_____

_____

_____

Reproduction

Read the information below and then use this information and research materials to answer the questions that follow. This is a reading and comprehension activity. Once you have finished reading and turned to the questions you are not allowed to reread this page.

Reproduction is the production of a new individual from an existing or existing individuals.

As all individuals have a limited lifespan and eventually die, reproduction is important to replace these individuals to maintain numbers of the organism. This is called continuity of the species. In most advanced organisms, at least some individuals of a population have to survive to sexual maturity and reproduce at least two offspring per pair for that population to continue to exist. If this does not occur then population numbers may drop and the species may become extinct.

There are two main forms of reproduction sexual and asexual.

Asexual reproduction is the most simplistic form of reproduction and does not involve the production of or joining of sex cells (gametes). Aphids are an example of an animal that can reproduce asexually. These organisms are able to produce large numbers of offspring very quickly (when conditions are favourable) however all the aphids are genetically exactly the same. For this reason whole populations of aphids can also be killed very quickly.

Sexual reproduction is a more advanced form of reproduction and does involve the production and joining of gametes (sex cells), it usually involves two parents. In animals the male gamete is called the sperm and the female gamete is called the ova. Sexual reproduction is generally a slower process than asexual reproduction however organisms produced sexually are not genetically identical to the parent/parents. This variation produced by sexual reproduction usually means that some organisms in a population will survive when conditions are not favourable helping the species to survive.

Below is a table showing the types of reproduction in various organisms.

Asexual reproduction	Sexual Reproduction
Potato	Earthworm
Amoeba	Fish
Jellyfish	Birds
Flatworm	Reptiles
Paramecium	Mammals
Aphid	Bee

Reproduction in humans

In humans reproduction is sexual, fertilisation occurs internally, development is internal and we give birth to live young. The male produces his gamete (sperm) and the female produces her gamete (ova). After coitus (sex) these two gametes can unite (fertilisation) to produce a single cell called a zygote. Once formed, the zygote grows by cell division into a multi cellular individual.

As both parents are involved in the production of gametes, genetic information is transferred from both parents to the offspring. This combining of genetic material results in a number of genetic similarities and differences (variation) to each of the parents.

Human reproduction has a number of advantages;

- It is sexual resulting in variation in the offspring and therefore the population. This variation helps to preserve the human population in the event of changes in environmental conditions.
- Fertilisation is internal thus increasing the likelihood of it taking place.
- The young develop within the female uterus obtaining their requirements via a placenta. This means that they are constantly provided with the requirements for growth, are protected from the external environment and constantly 'carried' with the mother.
- The long period of gestation means that the offspring are born 'fully' developed. However due to the size of the human brain/skull and female birth canal humans are not born as fully functional as other mammals.
- The long period of infant dependency allows the passing on of knowledge (learning) and reduces the death rate caused by learning by direct experience.

To answer the questions that follow it is suggested that you use the 'two heads are better than one' strategy and form a group to discuss the questions and formulate the answers.

Questions

1. How would internal fertilisation increase the likelihood fertilisation taking place?

   _____

   _____

   _____

2. Why don't all organisms that reproduce sexually use internal fertilisation?

   _____

   _____

   _____

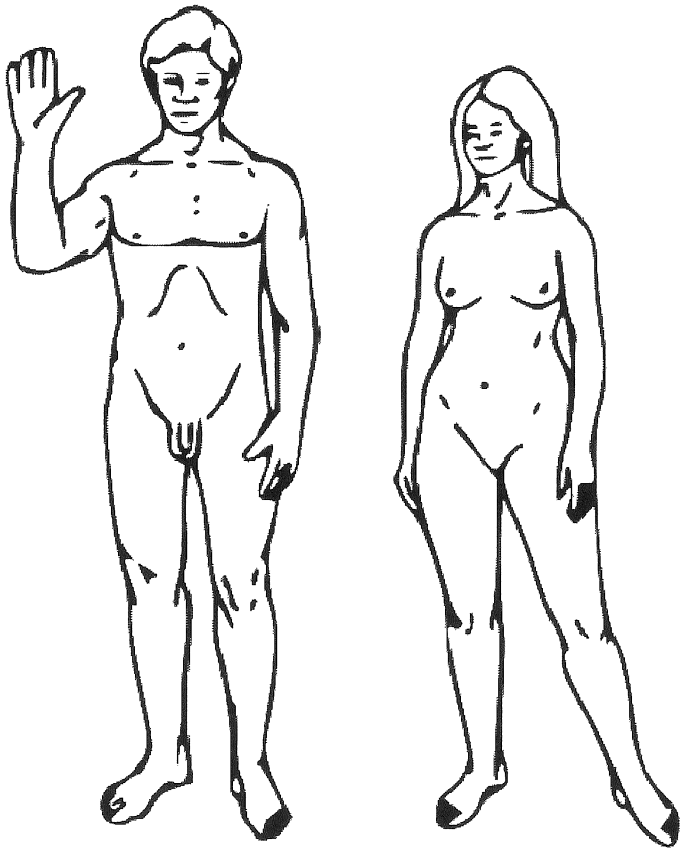
Sexual dimorphism

To allow for the production of gametes, promotion of sexual behaviour, sexual intercourse, internal fertilisation, gestation, birth and breast feeding there are a number of differences between males and females. These differences are termed sexual dimorphism.

Sexual dimorphism can be divided into two basic types, sexual structures and secondary sexual characteristics.

Sexual Structures involve differences in the external anatomy eg scrotum & labia and internal anatomy eg testes & ovaries.

Secondary sexual characteristics involve differences in body & facial hair, voice, subcutaneous fat placement, size & strength and breast development.



The images above are from the 'Pioneer plaques', a pair of gold anodised aluminium plaques which were placed on board the Pioneer 10 and Pioneer 11 spacecraft, featuring a pictorial message from humanity, in case either Pioneer 10 or 11 are intercepted by extraterrestrial beings. The plaques show the nude figures of a human male and female along with several symbols that are designed to provide information about the origin of the spacecraft.

Use the internet or another information source to describe the function and basic structure of the following primary and secondary sex organs on the following diagram of the male reproductive system.

	Structure	Function
testes		
scrotum		
penis		
erectile tissue		
glans		
foreskin		
bulbo-urethral glands		
urethra		
prostate gland		
seminal vesicles		
epididymis		
vas deferens		

Use the internet or another information source to describe the function and basic structure of the following primary and secondary sex organs on the following diagram of the female reproductive system.

	Structure	Function
ovaries		
uterine funnel		
uterine tubes		
uterus		
cervix		
vagina		
clitoris		
urethra		
labia majora		
labia minora		

Research assignment

Chose one of the following topics to research or if you have a topic you would like to research then discuss it with your teacher.

Your research should concentrate on the relationships between structure and function.

1. What occurs to makes males bones in their shoulders and female bones in their hips 'widen' during puberty.

2. What causes pubic hair to grow and be different to normal body hair?

3. Why do males get increased body hair after puberty?

4. What processes occur within the female breast that makes it 'grow' during puberty?

5. What happens in females to cause the increase in fat on the buttocks and thighs during puberty?

6. What occurs in the penis to make it become erect?

7. How and why does the scrotum change in size in response to changes in temperature?

8. What occurs to the male larynx that results in their deeper voices?

9. What is the function of a wet dream?

10. What is the cycle of changes within the uterus during a menstrual cycle?

11. What is the cause of the abdominal cramps that can occur during a 'period'?

12. How does oestrogen actually 'cause' the changes that occur to females during puberty?

13. How does testosterone actually 'cause' the changes that occur to males during puberty?

14. What signs would a doctor/pathologist look for to indicate if a person/body was 'fully grown'?

The gene concept

The Gene Concept has a long history of evolution of understanding. A detailed explanation and sequence can be obtained from the PhD Thesis of Grady Venville, available at http://adt.curtin.edu.au/theses/available/adt-WCU20020729.124342/.

For the purposes of this course we will use a simple concept of a gene as being a section of DNA whose sequence carries the instructions for the manufacture of proteins

A good site that discusses the gene concept is by Dr Karl Kruszelnicki and can be found at http://www.abc.net.au/science/k2/moments/s260728.htm

If you have access to the site read the article and answer the questions below.

Great Moments in Science - Mapping the DNA 2

1. Who has more DNA an amoeba or a human?

   _____

2. Is it correct to say that there is a gene for every part of the cell and body?

   _____

3. How many genes do humans have?

   _____

4. Explain why a single gene can produce different 'things'.

   _____

5. Do all chromosomes contain equal numbers of genes?

   _____

6. Besides our human ancestors where else did some of our DNA come from?

   _____

7. How much of our DNA is not actually used by us?

   _____

8. How much of our DNA is termed 'junk'?

   _____

9. How much of our DNA is actually used for useful genes?

   _____

Hemispheric Dominance in the human brain

Without thinking, clasp your hands together by interlocking the fingers. Which thumb is on top? 55% of people have their left thumb on top.
Now move your chair back from your desk and cross your legs at the ankles and fold your arms. For each member of the class, record which leg and which arm is on top in the table below.
As a matter of interest try crossing you legs and arm in the 'opposite' way to your normal pattern. How does it feel?

Name	Leg on top when crossed at ankles (Left / Right)	Arm on top when folded (Left / Right)

Calculations
Total number of students examined = _____

Total number of students that had left arm on top = _____
Total number of students that had right arm on top = _____
Percentage of students that had left arm on top = _____
Percentage of students that had right arm on top = _____

Total number of students that had left leg on top = _____
Total number of students that had right leg on top = _____
Percentage of students that had left leg on top = _____
Percentage of students that had right leg on top = _____

Visual hemispheric dominance

Exercise 1 for observing visual hemispheric dominance

1. Extend your arm outwards and hold up your index (pointer) finger.

2. Look at a distant object/point and position your finger at the centre of your field of vision when using both eyes.

3. Alternately close your left and your right eye.

4. You should notice that the 'image' of your finger moves either right or left of the point.

5. The eye in which your finger 'moves' the least is your dominant eye and is controlled by the opposite brain hemisphere.

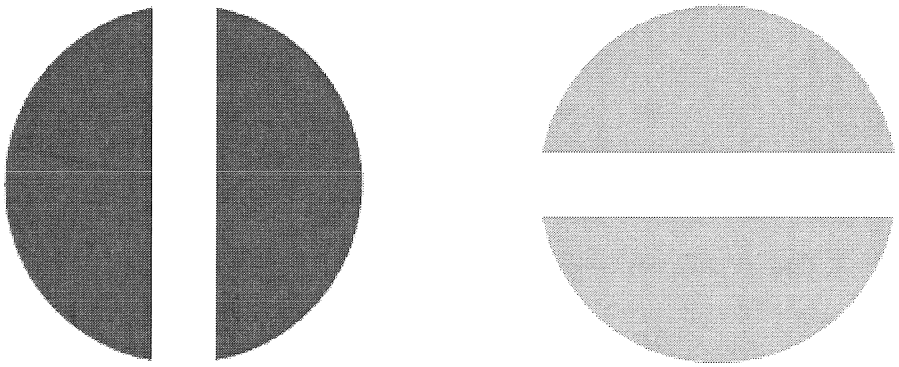
Exercise 2 for observing visual hemispheric dominance

As you look at this illustration, cross your eyes so you see a third circle between the dark grey and light grey circles. When you get your eyes focused right, the middle circle will seem to have a cross on it.

The farther back you sit, the less eyestrain you'll feel. Sitting anywhere from 30 – 90 cm back works well.

Watch the cross on the third circle. Every few seconds, it will change from a horizontal line to a vertical line and back again. This is because the hemispheres of your brain are alternating in dominance for this activity.

When the right hemisphere is dominant you see the dark grey circle and vertical line on top; when the left hemisphere is dominant, the light grey circle and horizontal line are on top.



Genetics and the environment

In addition to their long life cycle it is not ethically possible to experiment on humans so we are going to look at the effect of genetics and the environment on plants.

In this activity you will examine the influence of the genes and the environment on a special form of barley called genetic barley.

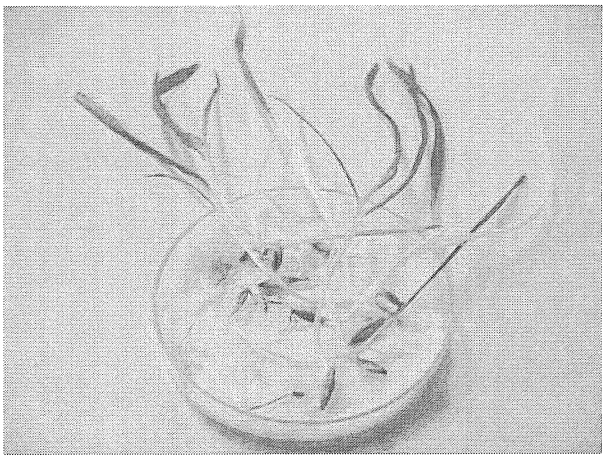
All green plants need light to make chlorophyll, if there is no light the plants will turn 'yellow'. This is most obvious when a patch of grass is covered by a solid object eg a piece of wood or sand/mulch. When it is removed after a number of days the grass has lost it's 'greenness'.

There are two types of genetic barley, type one has the genes for making the green pigment (chlorophyll) that plants need to photosynthesise. These seeds develop into green plants and are termed 'normal'. Type two does not have the genes to make chlorophyll. These seeds germinate into white/yellow plants and are termed 'albino'.

Aim – To examine the influence of the genes and the environment on the colour of barley.

Materials

- 2 x Petri dishes and lids
- 4 x filter paper
- 20 genetic barley seeds
- 2 x stickers
- Access to a dark cupboard and a well lit position



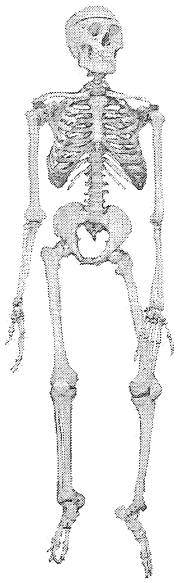
Procedure

1) Divide your class into groups and give each group a number.
2) Collect 2 Petri dishes and 2 stickers and label the bases of the dishes with your group number and either the word LIGHT or DARK.
3) Place two pieces of filter paper in each dish and moisten with water.
4) Place 10 genetic barley seeds in each dish.
5) Place BOTH dishes in a dark cupboard/draw and wait for the seeds to germinate (approximately 4-5 days).
6) When most of the seeds have germinated (some may be 'duds' and never germinate) keep the DARK dish in the draw but move the LIGHT dish to a well lit position eg a window sill, where it will receive sunlight.
7) After 2–3 days more days collect both dishes and count the number of green and yellow/white seedlings in each dish and record in the table.
8) Collect other student's results and add to your table and calculate the averages and percentages.

Anthropometric measurement

Anthropometry is the measurement of the human body. These measurements can be used to determine differences in individuals that could be due to gender, race, age or variations in growth patterns.

This activity involves the compilation of individual data into class averages. You will use these averages and your own results to complete a number of calculations.
Your teacher will discuss with you how your individual data will be transferred to other student's and how the class averages will be calculated.



Aim – To make a number of anthropometric measurements to demonstrate:

a) Variation and similarities between individuals.
b) Differences due to gender.
c) Differences due to age.

Materials

- Ruler
- Head calliper
- Vernier calliper
- Pincer calliper
- Scales

Procedure

Make each of the following measurements by carefully following the instructions. All results should be recorded using the correct units in the results table.

Note

- You should make all measurements on the dominant side of the body.
- All measurements should be in the units specified in the explanation and rounded off to whole numbers (this will make calculating the averages much easier).
- Refer to the explanatory diagrams for precise measuring points.

1) Standing Height - The subject should be bare footed and in the anatomical position, with the arms inwardly rotated. Measure from the floor to the top of the skull. (unit – cm)
2) Weight - Measure your weight using the scales, deduct some weight for clothing. (unit – Kg)
3) Head Length - Measure the skull at its longest point ie from front to back. (unit – mm)
4) Head Width - Measure the skull at its widest point ie from side to side. (unit – mm)
5) Nose Length - Measure the subjects nose from nose tip to the bridge of the nose. (unit – mm)
6) Nose Width- Measure the subjects nose at its widest point. (unit – mm)
7) Width between Eyes - Measure the distance between the inside corner of the left eye to the inside corner of the right eye. (unit – mm)

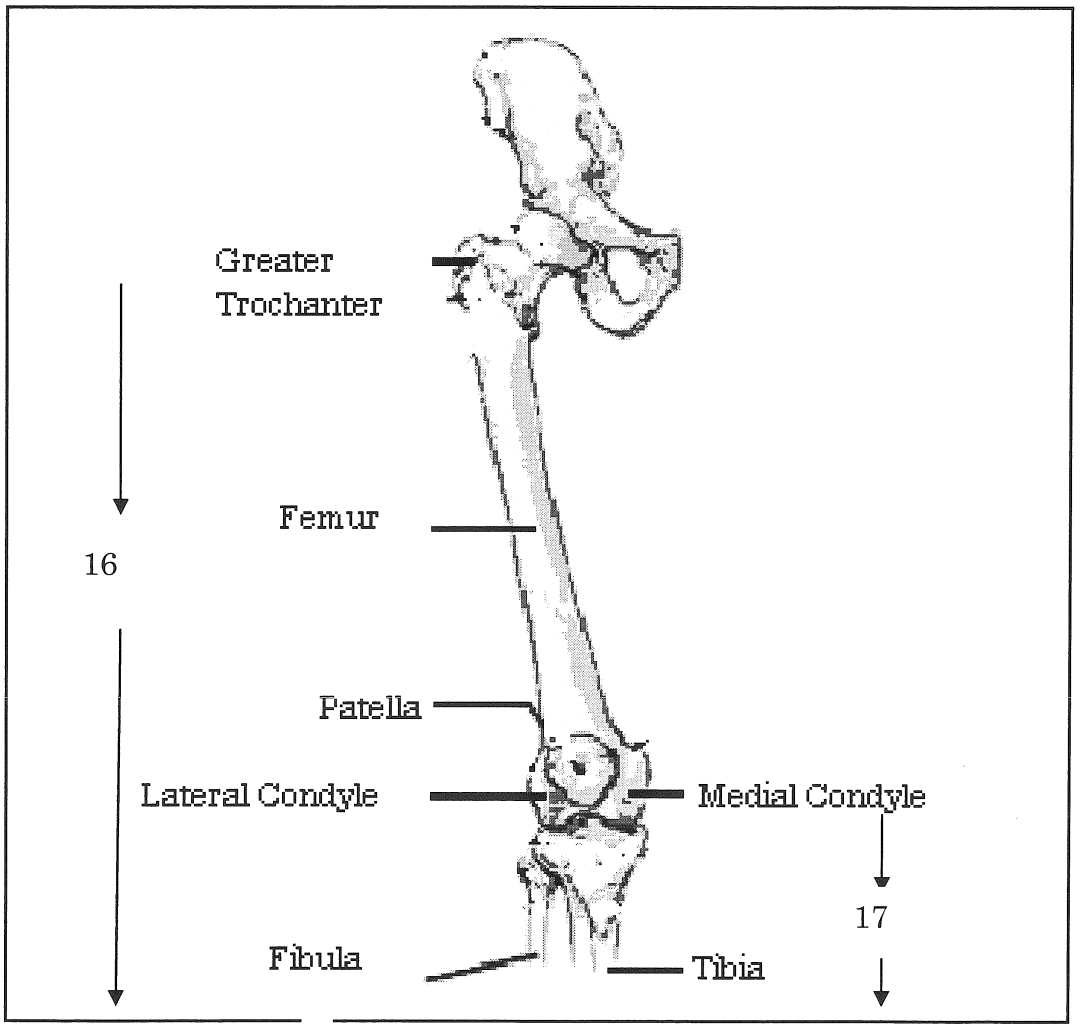
15) Hip Width - The subject should be in the anatomical position with the arms inwardly rotated. Measure from the superior surface of one greater trochanter to the other. (unit – cm) (see diagram)

16) Lower Extremity Length - The subject should be in the anatomical position with the arms inwardly rotated. Measure from the floor to the superior surface of the greater trochanter of the femur. (unit – cm) (see diagram)

17) Lower Leg Length - The subject should be in the anatomical position with the arms inwardly rotated. Measure from the floor to the medial condyle of the tibia. (unit – cm) (see diagram)

18) Foot Length - The subject should be in the anatomical position with the arms inwardly rotated. Trace the foot outline on to a piece of paper. Measure the foot length from the distal point of heel to the distal point of the second digit. (unit – mm)

19) Foot Width - The subject should be in the anatomical position with the arms inwardly rotated. Trace the foot outline on to a piece of paper. Measure the foot width across the metatarsal bones at their greatest width. (unit – mm)



Questions

1. Calculate the cephalic index of your head. (show your working)

   Head width / Head length x 100

   Less than 75 = long narrow head
   75 – 80 = medium head
   Greater than 80 = short broad head

   Answer = _____ Head classification = _____

2. Calculate the average value for each of the 19 measurements and add to the table. Describe in the space below how you calculated the averages.

   _____

   _____

3. Identify males and females on the table then calculate the average value for males and females for measurement number 9, shoulder width (show your working in the space below).

   Males (9 ave) = _____ Females (9 ave) = _____

4. Calculate the average value for males and females for measurement number 15, hip width (show your working in the space below).

   Males (15 ave) = _____ Females (15 ave) = _____

5. Explain possible reasons for the differences in these two values.

   _____

   _____

   _____

6. Calculate the ratio of shoulder width to hip width for yourself, the male average and the female average (show your working).

   You = _____

   Male average - _____

   Female average - _____

7. How does your ratio compare to the male and female average ratios? Explain.

   _____

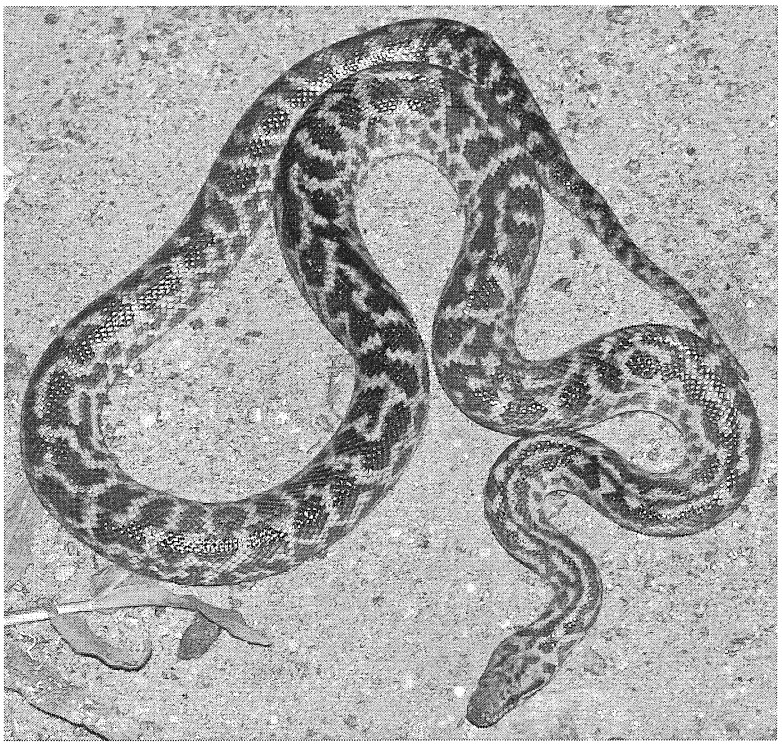
   _____

   _____

Classification

Human Biological Sciences or Human Biology which studies the structure and function of the human body. But what are humans or more importantly *Homo sapiens* and how do we differ from other organisms. Many people can obviously recognise humans (or I hope you can!!) but when it comes to describing how humans are different to other animals it can be more difficult.

Let's start with a relatively easy example. People can readily distinguish between humans and snakes but would be surprised at how many structural characteristics that they have in common. In the following table write down as many structural similarities and differences as you can for humans and snakes. *Teachers see Teachers Guide*



Spotted python
(*Antaresia maculosa*)
© Stewart Macdonald

Comparison of structural characteristics of humans and snakes

	Similarities	Differences	
		Snake	Human
Body shape			
Body covering			
Internal anatomy			

The characteristics of humans

Now write a short statement that describes what you think are the characteristics of humans (structural and functional) including those that make us different from all other animals.

Read or show your statement to other members of the class and see if they can come up with the name of another animal that could fit this description.

Your teacher will give you an 'experts' definition of a human. *Teachers see Teachers Guide*

As you may have found out humans are in many ways very similar to other animals; the characteristics that make up the species *Homo sapiens* can be difficult to define. Humans are an amazing organism similar in so many ways to others but also uniquely different. The study of humans has captivated humans for thousands of years as there is nothing more interesting than studying how you function.

Questions

1. Write down your characteristics based on the key.

2. Use the key to see if your teacher has a 'perfect match'?

3. Which characteristics were directly observable?

4. Which characteristics required information from the class members?

5. Which characteristics would most likely not change if this key was used again next week?

6. Which characteristics used in the key are the least reliable? Explain.

Extension questions

7. Was using non structural criteria easier or more difficult? Explain

8. Why do you think biologists mainly use structural characteristics when classifying organisms?

The tree of life

If you have access to the internet go to the URL http://tolweb.org/tree/ and open the Tree of Life Page. Starting from the root of the tree see if you can find out the 20 names or classifications for humans and add any relevant information to the table.
Teachers see Teachers Guide

Name	Characteristic
Eukaryotes	
Vertebrata	
Terrestrial Vertebrates	
Mammalia	
Hominidae	
sapien	

Types of graphs

Once you have recorded your results in a table a graph is often an appropriate way of presenting the data to the reader of the report. Many times any differences or trends in the results can be more clearly presented and observed in a graph.

In science two main types of graphs are used in scientific reports, these are the line graph and the column graph.

Line graphs are used for continuous data that is data where each measurement is related to the others, for example measurement of a plants height each week.

Column graphs are used for data that is not continuous or discrete this is when each measurement is not related to the others for example the heights to which different types of balls will bounce on a particular surface.

All graphs

- All graphs require a title and labels on scaled axes with units and data.
- The title should be clear and concise and include the independent and dependent variables. In general the longer a title is, the better, a person should be able to read the title and know what the graph is going to show them before looking at it.
- When determining and labelling the axes the independent variable should be placed on the horizontal or X axis and the dependent variable on the vertical or Y axis.
- Appropriate units should be included with the labels if required. Each axis should be scaled (marked off into units) to cover the entire range of the measurements. If the data is not evenly spread over a scale from 0 to the highest / largest datum point then the scale should be 'broken' in an acceptable manner.
- When plotting points on a line graph dots or small crosses should be made for each pair of values and then joined by ruled lines. In column graphs columns of different heights are used to represent the data and if appropriate they can be shaded or coloured in.

Column graphs

Column graphs are more suited to discrete data that makes direct comparisons between unrelated things or occurrences (eg, the amount of salt in different types of soup or the amount of rain in different months of the year). They are used when dealing with numbers of particular types, groups or categories of things.

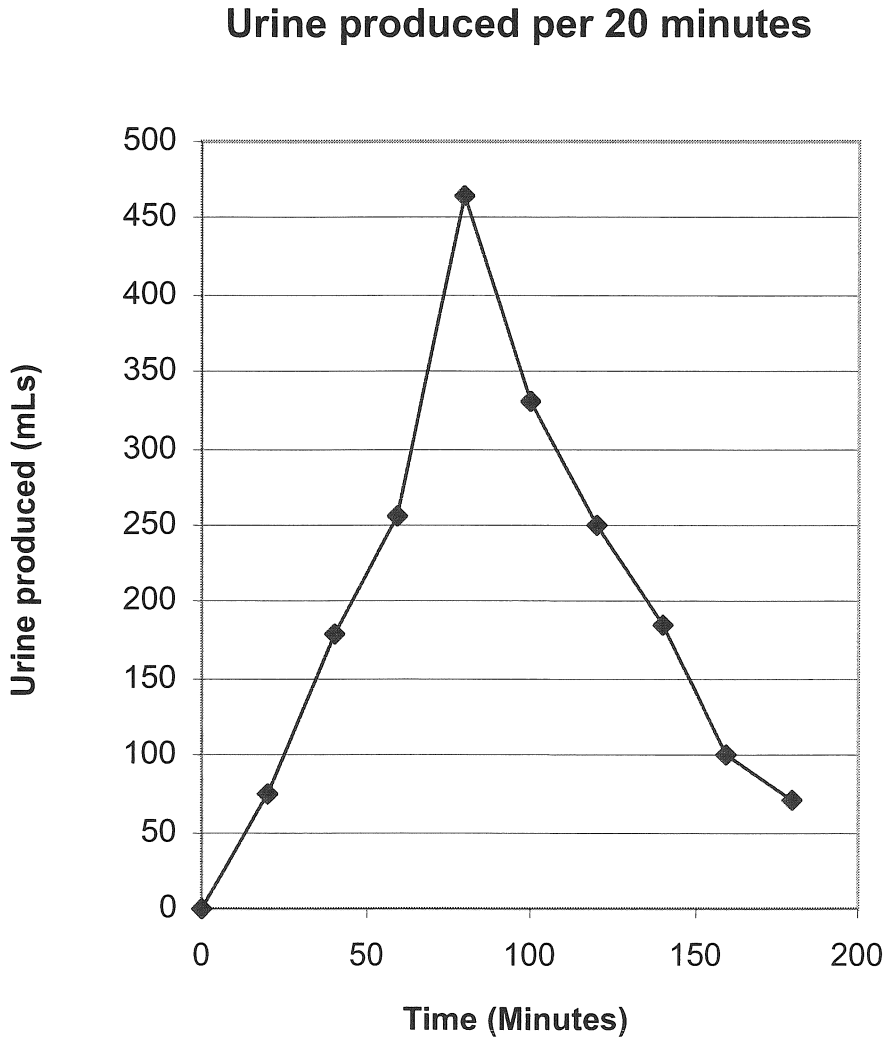
For example: The column graph on the next page shows the results of an investigation on the number of cars in a car park by type. The data is discontinuous, as each of the measurements is unrelated to the others.

Line graphs

Line graphs are generally used when the data is continuous and results are taken over a period of time (eg, growth of a plant taken every day for two weeks or change in temperature every hour over a day).

They usually have two factors that are changing (eg, time and temperature).

For example: The line graph below shows the results of an experiment on the volume of urine produced after drinking 2 litres of water. The data is continuous over a number of hours so the line graph is the most suitable way of representing the data.



9) Record, in the results table, the level of the 'bubbled froth' at time zero and then every minute up to 20 minutes or until the foam reaches the top of the cylinder.
10) Obtain the data for 'no sugar' from your teacher
11) Draw a graph of your results and the control results on the grid on the following page.
12) Write a conclusion for this experiment.

Results

	Height of froth (mm)	
Time (minutes)	**With sugar**	**No sugar**
0		
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		
15		
16		
17		
18		
19		
20		

Extension

This experiment could be extended by having multiple experimental setups and varying;

- The amount of yeast
- Amount of sugar
- Water temperature.

How to design and conduct an extended investigation

An extended investigation requires you to take or make readings (collect data) over a number of days or weeks.

The following pages model a procedure you can use when completing an extended investigation task.

In any scientific investigation, there are four main stages.
1. Identifying the aim of the investigation including clarifying the task and writing the hypothesis.
2. Planning the investigation including variables, procedure, resources and safety risks.
3. Carrying out the investigation including collecting resources, drawing diagrams, collecting data and presentation of results.
4. Preparing a report including material covered above plus conclusions, modifications and improvements.

Task Description

A student had been taking their pulse rate every day as part of a classroom activity and made the observation that her pulse rate varied on different days. This gave her the idea that it might have something to do with the day of the week the pulse was taken on.

She decided to design and conduct an extended investigation over three weeks (starting on a Saturday) to see if her pulse rate is lower on a weekend than on a school day, and then write a report on her findings.

Her report should include;
- the hypothesis you will be testing
- the variables that you have identified (independent, dependent and controlled)
- how you conducted the investigation, including how measurements were taken and recorded
- results tables and graphs
- A conclusion about what you have found out from this investigation and how the investigation could be modified for future use.

1. Writing a hypothesis?

A hypothesis is a simple explanation for the original problem based on observations. It attempts to explain how the independent variable might influence the dependent variable. It contains a single testable idea.

In our example investigation the hypothesis could be;

"That my pulse rate will be lower on Saturday / Sunday than on school days".

3. Carrying out the investigation

Diagram of investigation

You should draw a diagram where possible to help explain the procedure. Diagrams are also useful to help reduce errors. Diagrams should be in pencil, 2-dimensional (side view), labelled, large and clear.

In our sample task no diagram is required but in many extended investigations a diagram would be appropriate.

Presentation of results

It is often a lot easier to read information when it is organised into a table, graph or diagram rather than described in lines of text. In presenting the results of an experiment, you need to decide on how best to present the data.

In most experiments results are recorded directly into a table. Your table should always have a clear and accurate title and a set of rows (across) and columns (down). The rows/columns should have clear headings including units where necessary. It should also, where appropriate, show a number of trials, an average and a percentage. This is a good example of a table.

PULSE RATE ON DIFFERENT DAYS

WEEKS	Pulse Rate on Different Days (Beats per minute)						
	Sat	Sun	Mon	Tue	Wed	Thu	Fri
1	75	78	81	74	88	82	77
2	73	75	75	77	79	77	80
3	76	81	78	76	77	74	87
Average	74.7	78.0	78.0	75.7	81.3	77.7	81.3
Average	76.4		78.8				

The next step is to use the results in the table to draw a graph. In most cases differences or trends in results can be more clearly represented by a graph.

In science two main types of graphs are used, line graphs and column graphs. Line graphs are used for continuous data (eg increase in height of a plant as it grows). Column graphs are used for data that is not continuous, discrete (eg heights to which different types of balls bounce).

4. Preparing a final report

The task report should cover all of the information previously outlined.

Writing a conclusion
The conclusion is always towards the end of an experimental report. Conclusions should be brief and not introduce any new ideas or information. A conclusion should be presented in a series of separate statements.
Conclusions state:

- if the data supports or disproves the hypothesis (backed up with results)
- any inferences which can be drawn from the data.

The following would be a good conclusion for our sample task.

The results of this extended investigation support the hypothesis "That my pulse rate will be lower on Saturday / Sunday than on school days". My average pulse rate for weekend days was much lower than on school days. On the weekend my average pulse rate was 76.4 bpm and on school days it was 78.8 bpm. These differences could be due to all of the activities I do during the week. On weekends I spend a lot of time sleeping and sitting around watching TV.

Modifications / improvements
Modifications and improvements can often be suggested at the end of an investigation to help improve future experimental work. You need to think about the procedures of your investigation and any problems that you may have had and suggest modifications or changes.

For example, you would write.

- If I was to repeat this investigation I would take the pulse rate twice a day at 7.30 am and 7.30pm. This would result in a broader range of results.
- I would also suggest doing the readings for a longer period of time.
- I would test a number of people in my investigation to reduce the chance of the results being particular to me not to other people in general.