GCSE

Edexcel GCSE in Science
Genes

(Concept approach)

February 2006

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Support material

Edexcel GCSE in Science
Genes
(Concept approach)

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Scheme of work for Topic 2: Genes

LESSON 1: Asexual reproduction							
Spec. code	**Links and concept building from KS3**	**Learning objectives**	**Teaching activities**	**Resources**	**Learning outcomes**	**Key skills**	**Safety issues**
B1 a 2.5	7A Cell division. 9A Inheritance and selection.	Consider the implications of reproduction of individuals. Understand biological facts about asexual reproduction. Understand that a variety of organisms demonstrate asexual reproduction.	**Starter** One bacterium reproduces every 20 minutes. Calculate how many bacteria there will be after two hours and after 24 hours. **Main** Introduce the idea of asexual reproduction producing genetically identical offspring. Examples of vegetative reproduction to include bulbs, corms, runners, stolons, rhizomes and tubers. Demonstration sheet 2.1: Observe yeast cells growing in optimal conditions for budding cells. **Plenary** Discuss the advantages and disadvantages of asexual reproduction. Why might someone want to clone a potato or strawberry plant — or a sheep? Easy to clone plants but technically harder to clone animals/humans.	Calculators. Visual props, such as *Chlorophytum* (spider plant) or Bryophyllum. Demonstration sheet 2.1 Microscopes, slides, coverslips, pipettes.	Describe how asexual reproduction leads to genetically identical individuals called clones, including *Chlorophytum* (spider plant).	N 2.2 2.3 C 2.1	See Demonstration sheet 2.1
Homework: Consider why a woman/man might prefer to have a child produced by cloning rather than by sexual reproduction.							

Scheme of work for Topic 2: Genes

LESSON 2: Genes in a bottle							
Spec. code	**Links and concept building from KS3**	**Learning objectives**	**Teaching activities**	**Resources**	**Learning outcomes**	**Key skills**	**Safety issues**
B1 a 2.1 B1 a 2.2 B1 a 2.3	7A Cell division. 9A Inheritance and selection.	Characteristics of organisms are dependent on their genes. Use solubility techniques to isolate DNA.	**Starter** Recall structure of a cell and contents of nucleus. **Main** Discuss the human genome project and how it can be used in forensic science. Chromosomes are made up of genes, which are made up of DNA. A gene is a section of DNA responsible for a particular cell function, represented by a code with only four different bases. The CF gene is a faulty version a gene. The normal version enables the cell to produce mucus that is neither too sticky nor too runny. Explanation of genetic code in terms of base sequence determining protein structure. Students can isolate their own DNA. See Experiment sheet 2.2. **Plenary** Discuss how this technique of extracting DNA could be used by forensic scientists in solving crime.	Models/CD ROM or video to show double helical structure of DNA with base pairing. There are many techniques available for isolating DNA from plant material such as onions or kiwi fruit. I recommend that the students extract their own DNA which they can take home in a bottle (see Experiment sheet 2.2). Bio-Rad Laboratory 'Genes in a Bottle' kit. Bio-Rad Laboratories Ltd. Bio-Rad House Maxted Road Hemel Hempstead Hertfordshire HP2 7DX Telephone: 0800 181134/ 020 8328 2000.	Describe genes as parts of chromosomes which are found within the nucleus and which controls the cells activity. Explain that the unit of inheritance is a section of a long chain (DNA) molecule. Describe some of the implications of the Human Genome Project to include the use of DNA evidence in forensic science and medicine *(part)*.	N 2.3	Safety issues associated with DNA isolation — see 'Genes in a Bottle' kit manual.
Homework: Find out what is unusual about the chromosomes of someone with Down's syndrome, and how gender is controlled by chromosomes in humans.							

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LESSON 3: Variation from sexual reproduction							
Spec. code	**Links and concept building from KS3**	**Learning objectives**	**Teaching activities**	**Resources**	**Learning outcomes**	**Key skills**	**Safety issues**
B1 a 2.6	7B Reproduction.	Sexual reproduction leads to variation. Sex cell contains half the number of chromosomes as somatic cells. Understand the concept of dominant and recessive genes.	**Starter** Discuss the events involved in fertilisation. Use diagrams and video clips showing the acrosome, fertilisation membrane, penetration of sperm into egg and entry of paternal chromosomes. **Main** Make a sperm, egg and fertilisation flipbook animation. Number of chromosomes in a sperm and egg necessary to ensure the zygote has the full chromosome complement. Sperm and egg had genes from father's and mother's genotype. Sperms and egg cells are produced in ovaries and testes by a special kind of cell division in which each egg or sperm receives only one of each pair. Haploid versus diploid. **Plenary** Is having such a lot of sperms wasteful or does it lead to variation?	Diagrams and/or video clips.	Explain how sexual reproduction, involving fertilisation, leads to variation in the new generation.	C 2.1	
Homework: Explain how the way grass pollen being blown a long way by the wind will increase genetic variation.							

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LESSON 4: The different forms of a gene							
Spec. code	**Links and concept building from KS3**	**Learning objectives**	**Teaching activities**	**Resources**	**Learning outcomes**	**Key skills**	**Safety issues**
B1 a 2.8	7B Reproduction.	Sexual reproduction leads to variation. Understand the concept of dominant and recessive genes.	**Starter** List FAQs students would put on a website telling people about inherited and environmental characteristics. Collect suggestions as a whole-class activity, steering students towards those related to the objectives. Conclude by highlighting the questions you want them to be able to answer at the end of the lesson. **Main** Although the rest of the lesson is aimed at higher tier students, foundation students would benefit from extending material from previous lessons instead. Why have I got blue eyes when both my parents had brown eyes? Discuss the concept of dominant and recessive genes. Simple genetic diagram to show there is a one in four chance of a child receiving a different phenotype from two parents. Set up a breeding experiment (see resources section) to run for several weeks to illustrate the principle of recessive versus dominant. **Plenary** Consider Huntington's Chorea as an example where defective gene is dominant.	Breeding experiment using material from biological suppliers: • rapid cycling brassica simple genetics kit — see Science and Plants for Schools (SAPS). • www-saps.plantsci.cam.ac.uk • genetic tomato or tobacco kits — see Philip Harris catalogue. • interbreed F_1 progeny of a *Drosophila* experiment — may be surplus from A level work elsewhere in your centre — cross F_1 to get recessive alleles expressed in F_2. • computer simulations of Pea Plant and Drosphila genetics from Newbyte Software www.newbyte.com.	Explain how alternative forms (dominant and recessive) of a gene (alleles) cause variation in a characteristic.	C 2.1	
Homework: If a man suffering from cystic fibrosis marries a woman who does not have the disease what is the chance that their children will suffer from cystic fibrosis? Show this in a genetic diagram.							

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LESSON 5: Changing appearances							
Spec. code	**Links and concept building from KS3**	**Learning objectives**	**Teaching activities**	**Resources**	**Learning outcomes**	**Key skills**	**Safety issues**
B1 a 2.7	9A Inheritance and selection.	Characteristics of organisms are dependent on their genes. Some inherited characteristics can be modified by environmental conditions.	**Starter** Investigate height distribution among class members. **Main** Investigate a diet and height case study: compare data on child physical development in poor and affluent areas. How does the environment affect the growth of genetically identical individuals? Use *Chlorophytum* (spider plant) clones planted in essential element and element-deprived solutions. Observe their growth over the next few weeks. See Activity sheet 2.5. This sheet is accessible to all abilities. **Plenary** Discuss why a pair of identical twins who were separated at birth and brought up one in the UK and one in Australia might be different and why they might be same eg which would be the more sun-tanned and why?	Data on child physical development in poor and affluent areas. Elements and plant growth practical is well documented in many Biology textbooks. The only difference here is the use of *Chlorophytum* clones. See Activity sheet 2.5.	Explain how some inherited characteristics can be modified by environmental conditions, including the influence of diet on human growth and mineral resources on plant growth.	C 2.1	Cuts in the hands should be covered before handling soil.
Homework: Two people of similar size and shape like to go on holiday together and sunbathe on a beach next to each other for an hour each day wearing similar bathing costumes. One always goes a nice shade of brown but the other gets red and sore. Suggest some genetic and some environmental reasons for this difference.							

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LESSON 6: Inherited diseases							
Spec. code	**Links and concept building from KS3**	**Learning objectives**	**Teaching activities**	**Resources**	**Learning outcomes**	**Key skills**	**Safety issues**
B1 a 2.9	9A Inheritance and selection.	Understand pedigree diagrams.	**Starter** Discuss royal family pedigree diagram outlining the inheritance of haemophilia. **Main** Analysis of pedigree diagrams showing inheritance of conditions such as cystic fibrosis, Huntington's disease, haemophilia, muscular dystrophy. Questions may be set from these diagrams to assess the students' understanding of inheritance. Discuss the relative proportions of recessive characteristics. Note the characteristics skipping generations. Explain and identify the carriers. Students should construct a pedigree diagram of their own to show inheritance of particular characteristics, or use data provided. **Plenary** Review the use of pedigree diagrams in tracing inheritable diseases.	Royal family pedigree diagram. Other pedigree diagrams.	Describe some alleles as causing diseases can be inherited.		Sensitivity towards students who may have family histories of genetic disorders, or with students of unknown parentage.
Homework: A couple who want to have children visit a genetic counsellor and both have a family history of cystic fibrosis although neither shows any signs of the disease. Write a dialogue for the interview.							

Scheme of work for Topic 2: Genes

LESSON 7: Human Genome Project							
Spec. code	**Links and concept building from KS3**	**Learning objectives**	**Teaching activities**	**Resources**	**Learning outcomes**	**Key skills**	**Safety issues**
B1 a 2.3	9A Inheritance and selection.	Characteristics of organisms are dependent on their genes. Understand the Human Genome Project. Know that DNA profiling can be used in forensic science and medicine.	**Starter** Video clip of a natural catastrophe, such as earthquake, tsunami or extreme weather. How are the victims identified? Discussion to lead to DNA profiling. **Main** If genes control how we develop what would be the benefits of knowing exactly how every gene is made up and where every gene appears on chromosomes? Discuss uses of DNA profiles in medicine, such as repair faulty genes eg CF, improved diagnosis of disease, and drug design. Recall uses of DNA profiles in forensic science. Who dunnit? Show pictures of DNA profiles used to identify potential suspects whose DNA may match evidence left at crime scenes or exonerate persons wrongly accused of crimes. The sexual assault case may be used from www.howstuffworks.com/dna-evidence.htm. **Plenary** Discuss other uses of DNA profiling (see homework activity).	Various Human Genome Project websites include: • www.yourgenome.org • www.ornl.gov Search for 'human genome'.	Describe some of the implications of the Human Genome Project to include the use of DNA evidence in forensic science and medicine.	C 2.1 ICT 2.2	Need for sensitivity to students who may have been involved in a natural catastrophe or who have loved ones in catastrophe areas.
Homework: Research other uses of DNA profiling. These could include: identify catastrophe victims, study migration of different population groups, establish paternity and other family relationships, identify endangered and protected species, match organ donors with recipients in transplant programs, or determine pedigree for seed or livestock breeds. Find an actual example.							

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LESSON 8: Treating genetic diseases							
Spec. code	**Links and concept building from KS3**	**Learning objectives**	**Teaching activities**	**Resources**	**Learning outcomes**	**Key skills**	**Safety issues**
B1 a 2.4	7A Cell division. 9A Inheritance and selection.	Characteristics of organisms are dependent on their genes. Enhanced sensitivity and empathy for those who have to cope with such conditions.	**Starter** Brainstorm some genetic diseases. **Main** Finding out what it is like to suffer from cystic fibrosis and breast cancer in terms of one effect on life-style and life expectancy. Understanding that cystic fibrosis is caused because something is wrong with a gene inherited from parents. Understanding that breast cancer is about normal genes going out of control. Less predictable than CF. Importance of early diagnosis. Understanding why the condition or just the fear of it is so distressing. **Plenary** Do conventional or genetic treatments treat symptoms of these conditions or do they offer a real cure?	Fact sheets available for cystic fibrosis and breast cancer on: www.bupa.co.uk	Discuss how the lives of two people would change, one suffering from cystic fibrosis and the other from breast cancer, if these diseases could be treated genetically.	ICT 2.1	Some pupils may be cystic fibrosis sufferers or be related to people with CF or breast cancer. Boys may not appreciate a woman's fear of breast cancer. Sensitivity in the handling of this lesson by the teacher is important.
Homework: Research either an aspect of coping with cystic fibrosis, the importance of early diagnosis/breast awareness in breast cancer or explain why either cystic fibrosis or breast cancer are not infectious like influenza.							

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LESSON 9: Creating and manipulating organisms							
Spec. code	**Links and concept building from KS3**	**Learning objectives**	**Teaching activities**	**Resources**	**Learning outcomes**	**Key skills**	**Safety issues**
B1 a 2.11 B1 a 2.10	9A Inheritance and selection.	Characteristics of organisms are dependent on their genes. Understand the social and ethical concerns of cloning mammals, including the possibility of cloning of human body parts for transplant surgery.	**Starter** Why do identical twins look and behave in a similar way? Identical twins resulting from the fertilised egg splitting into two viable zygotes, each with identical genetic make-up. **Main** Display photos or video clip of Dolly the Sheep. Discuss implications of cloning. Due to only about one or two viable offspring for every 100 cloned animals it would be unethical to attempt to clone humans. About 30% of clones born alive are affected with debilitating conditions. Several cloned animals have died prematurely. Scientists do not know how cloning could impact mental development. Discuss the problems associated with organ donation and the use of stem cells to minimise the risk of tissue rejection and the need for organ donation. Discuss the potential for using transgenic organisms: frost and spoilage resistance in plants, bacteria to digest toxic waste and oil spills, and mammals for research purposes.	Identical twins study: www.narth.com Cloning: www.ornl.gov Designer milk: www.sciencedaily.com and www.cbc.ca	Describe the social and ethical concerns of cloning mammals, including the possibility of cloning of human body parts for transplant surgery. Evaluate the potential for using transgenic animals including the production of 'designer milk' such as milk containing human antibodies, low cholesterol milk.	C 2.1	

Scheme of work for Topic 2: Genes

LESSON 9: Creating and manipulating organisms (continued)							
Spec. code	**Links and concept building from KS3**	**Learning objectives**	**Teaching activities**	**Resources**	**Learning outcomes**	**Key skills**	**Safety issues**
			What are the possibilities for the genetic engineer in producing designer milk: human milk from cows, lactose free milk, milk containing human antibodies, low cholesterol milk or milk with increased casein concentration for cheese making. Public awareness about animal welfare, environmental impact, regulatory processes, and food safety is necessary. **Plenary** Summarise the social and ethical concerns of cloning mammals and human body parts for transport surgery.				
Homework: Research and construct a time line showing the people and events that led up to the cloning of Dolly the Sheep.							

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LESSON 10: Designer milk for designer babies							
Spec. code	**Links and concept building from KS3**	**Learning objectives**	**Teaching activities**	**Resources**	**Learning outcomes**	**Key skills**	**Safety issues**
B1 a 2.12	9A Inheritance and selection.	Genetic modifications are used for a range of purposes. There are many ethical considerations associated with advances in genetic modification.	Although this lesson is aimed at higher tier students, foundation students would benefit from extending material from previous lessons instead. **Starter** Exactly 229 babies were born from sperm donated to the so-called Genius Sperm Bank a U.S. repository founded in the 1970s to collect sperm from Nobel prize winners and other scientists. What are the social, moral and ethical issues? What would ultimately happen to the human race if this sort of practice was allowed to continue? **Main** Is it ethical for doctors and parents to design a baby by selecting or altering an embryo they wish to bring to term? Should it be legal? Should there be limits to the practice? Arguments for and against designer babies can be found at www.tecsoc.org/biotech/focusbabies.htm. These may be copied onto cards and used in a class debate. **Plenary** Summarise the issues raised.	Useful websites: Go to the biotechnology link Designer babies: www.tecsoc.org Search for designer babies www.bbc.co.uk	Consider the contemporary theory of 'designer babies' and explain why today's scientists are finding so much opposition to this being publicly accepted.	C 2.1	
Homework: Should we be allowed to choose the sex of our children? Discuss.							

Demonstration 2.1: Budding yeast

What you will learn from this demonstration

In this demonstration you will observe yeast cells 'budding' under the microscope. You will find out how effective asexual reproduction is in increasing cell numbers over time.

What you will know after you see this demonstration

You will know how cells divide for growth in multicellular organisms, make direct observations of asexual reproduction in a single celled organism and practise graph-drawing, concluding and evaluating skills.

What you do

1 Predict how the yeast cells will grow in numbers as time increases.

2 Set up a microscope on your bench.

3 Using a clean pipette, put two drops of one of the yeast cultures onto a clean microscope slide. Cover it carefully with a coverslip.

4 Focus the microscope carefully using the lowest power objective lens until you can see the yeast cells clearly.

5 Count how many yeast cells you can see. Record this number. Observe the cells closely for 'budding'. Look closely at the new 'budded' cell. Is there any observable difference between the new cell and the parent cell? When you see a 'budding' yeast cell draw it carefully.

6 Repeat for the other cultures of yeast that have been left to grow for different times. Record your results. Make sure that you use the same magnification for counting each time.

7 Display your results in a suitable table. Plot a line graph of your results. Put time in minutes along the x-axis and the number of yeast cells you counted up the y-axis.

Questions

1 What were the visible differences, if any, between the new 'budded' cell and the parent cell?

2 Explain what pattern, if any, your graph shows. What does this tell you about the growth of yeast over time?

3 What were the limitations to your experiment? Are there any things that you would change about your method if you did this experiment again?

Suggestions for further work/homework

Find out what happens to all the genetic information in the nucleus of the cells when they divide.

Demonstration 2.1: Budding yeast

Notes for teachers and technicians

Aim

In this demonstration students will observe yeast cells 'budding' under the microscope. They will find out how effective asexual reproduction is in increasing cell numbers over time.

Skills, knowledge and understanding

This demonstration will enable students to gain the following skills, and/or knowledge and understanding:

- know how cells divide for growth in multicellular organisms
- make direct observations of asexual reproduction in a single celled organism
- draw graphs
- concluding and evaluating skills.

Previous skills, knowledge and understanding required

Students should be familiar with use of a microscope.

Equipment and chemicals required

A yeast culture needs to be set up in optimal conditions and split equally five ways. Leave it to grow in these conditions for 10, 20, 30, 50, 100 minutes and stop each by adding ethanol and putting on ice. Label the flasks to show which culture is which. Thoroughly re-suspend the yeast just before use.

Each group will need:

- a microscope
- five clean pipettes
- five slides and coverslips.

Health and safety issues

Ensure the yeast solutions are thoroughly suspended (agitate frequently). Ensure students use separate clean pipettes for each solution (you may wish to have them in different locations in the laboratory). Students should be warned about winding the microscope objective down too far and smashing the coverslip and slides. They should not use microscopes that need daylight illumination anywhere where direct sunlight can strike the mirror. Students should wash their hands after handling yeast.

Delivery strategies

Asexual reproduction is the quickest way for an organism to reproduce. A weed, for example, can colonize bare ground quickly by vegetative reproduction. When it reproduces asexually all the offspring retain the genetic make-up of the parent. All the offspring will be genetically identical to each other.

You may wish to set a time limit on making the observations, as graph drawing can be a lengthy process. Results could be collected in a spreadsheet and graphs drawn from that. A sample set of results could be set up in advance for group discussion or for groups who fail to gain satisfactory results.

Demonstration 2.1: Budding yeast

Links with other GCSE Science topics

This demonstration is related to:

- B2 2.1 describe mitosis as the division of a cell to produce two nuclei with identical sets of chromosomes, for growth or replacement
- B2 2.4 discuss the meaning of growth, in terms of increase in size; length; wet weight; dry weight
- B2 2.5 understand how cell division, elongation and differentiation contribute to the growth and development of an organism.

Links with key stage KS3

This demonstration builds on the following skills, knowledge and understanding from KS3:

- 7A cell division
- 9A inheritance and selection.

Experiment 2.2: Genes in a bottle

What you will learn from this experiment

With this simple experiment, you gain practical knowledge by conducting a real-world laboratory procedure that is used to extract DNA from many different organisms for a variety of applications. You will extract DNA from your own cheek cells and watch it precipitate from solution as floating white strands.

What you will know when you finish this experiment

You will extract DNA from cheek cells, review chromosome inheritance and structure, DNA location, structure, and function and conduct sophisticated scientific procedures.

How you may be assessed

You may be assessed on your fine manipulative skills during the practical.

What you do

1 Obtain a 15 ml tube containing three ml of water, and label it with your initials.

2 Gently chew the insides of your mouth for 30 seconds.

3 Take the three ml of water from your tube into your mouth and rinse vigorously for 30 seconds. Don't swallow the water!

4 Carefully expel all your water mouthwash back into your 15 ml tube.

5 Locate the 15 ml tube at your workstation labelled 'lysis'. Using a fresh disposable plastic transfer pipette, add two ml of lysis buffer to your tube.

6 Place the cap back in your tube. Gently invert your tube five times to lyse your cells. Don't shake the tube. If you observe any changes to your cells at this time, write them down.

7 Obtain the pink tube labeled 'prot' and add five drops of protease and salt solution to the 15 ml tube containing your cell extract. Cap the cell extract tube and gently invert it five times to mix.

8 Place your cell extract tube in the beaker or test tube holder in the 50°C water-bath (at the common workstation) for 10 minutes to allow the protease to work.

9 (You may need to do this step at the common workstation. Consult your teacher for specific instructions.) Fill a disposable transfer pipette with cold alcohol.

10 Tilt your 15 ml tube at a 45° angle and slowly add the alcohol, carefully letting it flow gently down the inside of the tube. Fill the tube with cold alcohol (about 10 ml total). You may need to use several pipettes full of cold alcohol. You should be able to see two layers (upper and lower) forming. As you add the alcohol, pay close attention to the place where the alcohol and cell extract layers meet. Write down your observations.

11 Place your 15 ml tube upright either on the cup or a test tube and leave it undisturbed at room temperature for five minutes.

12 After five minutes, look again at the contents of your tube, especially in the area where the alcohol and cell extract layers meet. Do you see anything? Write down your observations. Compare your sample with those of your classmates. With the cap of your tube tightly sealed, mix the contents of your tube by slowly inverting the tube five times. Look for any stringy, white or clear material. This is your DNA!

Suggestions for further work/homework

How do forensic scientists extract DNA from suspects? Find out what forensic scientists do next to make a DNA profile.

Experiment 2.2: Genes in a bottle

Notes for teachers and technicians

Aim

With this simple experiment, the students gain practical knowledge by conducting a real-world laboratory procedure that is used to extract DNA from many different organisms for a variety of applications. They will extract DNA from their own cheek cells and watch it precipitate from solution as floating white strands.

Previous skills, knowledge and understanding required

Cells contain a nucleus, which contains chromosomes. Genes are found on chromosomes, and genes are made of DNA. DNA codes for life. Everybody's DNA is different.

Skills, knowledge and understanding

They will extract DNA from cheek cells, review chromosome inheritance and structure, DNA location, structure, and function and conduct sophisticated scientific procedures.

Equipment and chemicals required

The following items are included in the Bio-Rad kit:

- lysis buffer — 150 ml
- powdered protease and salt — 1.5 g
- 15 ml conical tubes
- clear micro-test tubes
- multicolour micro-test tubes
- disposable plastic transfer pipettes
- foam micro-test tube holders.

The following items are also needed:

- 91% isopropyl alcohol or 95% ethanol — 250 ml
- container of ice
- permanent markers
- disposable paper cup or beaker for waste disposal
- beaker or rack to hold 15ml tubes in water bath.

Full detailed instructions will be issued with the kit.

Place the alcohol (isopropanol or ethanol) in the freezer at least one hour before beginning this experiment. Take the pouch containing the powdered protease and salt ('prot') and cut open one corner. Pour the powder into one of the 15 ml tubes. Add 15 ml of water to the 'prot'. Drinking water works well; distilled water, as used in laboratories, may be acceptable.

Once the 'prot' is rehydrated, it is good for up to a week if stored in a refrigerator, at 4°C. If you plan to use the kit for several groups of students over a few weeks, it is recommended that you measure out some of the protease for use now, and rehydrate the remaining protease for use later. The protease should be rehydrated at a concentration of 100 mg/ml. Aliquot 1.25 ml of the rehydrated 'prot' into eight pink micro-test tubes.

Experiment 2.2: Genes in a bottle

Aliquotting of solutions for each student workstation (four students/station)

1 For each student, dispense 3 ml of water into a 15 ml tube (up to four tubes per station). Any type of drinking water is acceptable.

2 Dispense 1.25 ml of the rehydrated protease and salt into nine pink test tubes and label the tubes 'prot'.

3 Dispense 10 ml of lysis buffer into nine 15 ml tubes. Label each tube 'lysis'.

4 Place four 15 ml tubes of water and one tube of lysis buffer in a cup or test tube holder, and one pink micro-test tube labelled 'prot' in a foam micro-test tube holder at each student workstation.

Teacher's (common) station

1 Water bath at 50°C with a beaker or rack that can hold up to thirty-six 15 ml tubes.

2 Ice-cold bottle of 91% isopropanol or 95% ethanol on ice.

Health and safety issues

Dispose of used mouthwashes carefully. Students should wash their hands before and after the experiment.

Delivery strategies

This activity is designed for any classroom environment and requires no specialised equipment or stains. It is a good introduction to the exciting world of DNA science. Lessons on DNA structure and function cell structure and enzyme function can be introduced or reinforced with this experiment. This procedure makes DNA visible — seeing their own DNA makes it real and helps students comprehend this previously invisible substance of life.

Links with key stage 3 (KS3)

This activity builds on the following skills, knowledge and understanding from KS3:

- 7A Cell division
- 9A Inheritance and selection — introduction of gene concept in contrast to environmental causes of variation.

Links with other GCSE Science topics

B2 1.1 describe a DNA molecule as two strands coiled to form a double helix, the strands linked by a series of paired bases (adenine with thymine and cytosine with guanine).

Resources

The Biro-Rad kit is available from www.biorad.com

Activity 2.5: Body mass indices

What you will learn from this activity

In this activity you will calculate body mass indices to find the effect of environmental factors on weight.

What you will know when you finish this activity

After this activity you will understand:

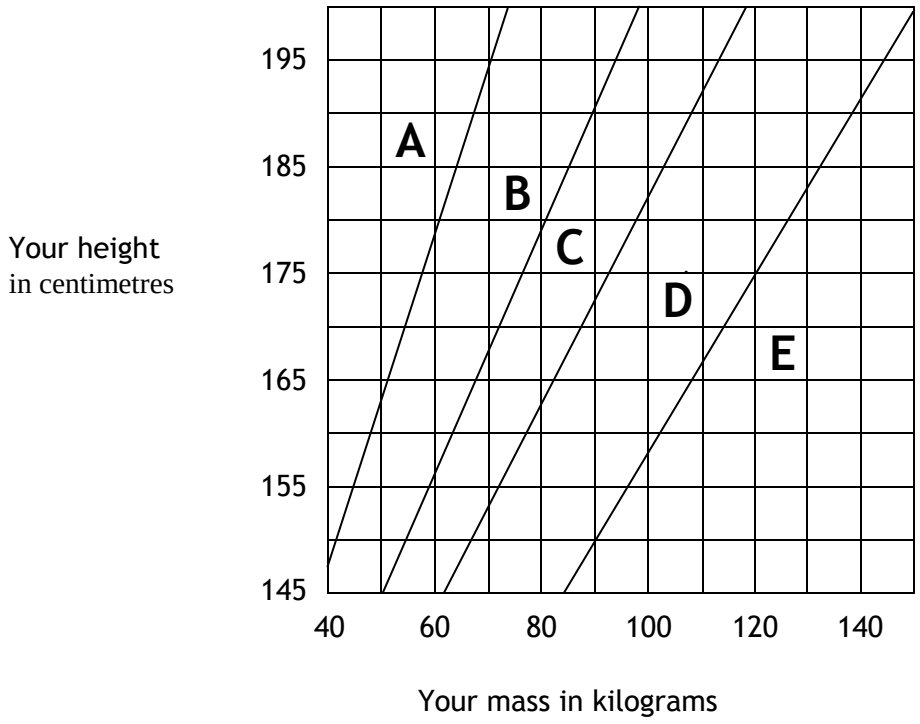
- body mass is an inherited characteristic that can be affected by environmental factors
- how life styles, and environmental factors, can affect body mass.

How you may be assessed

You may be assessed on your analysis of data and applications and implications of science.

What you do

When you get more energy from your food and drink than you burn up in daily activity, the spare energy is stored as fat and you put on weight. Your weight in relation to your height gives an estimate of how much of your body is made up of fat. This measure is known as the body mass index (BMI). BMI ranges include underweight, okay, overweight, obese and severely obese. BMI is measured in kilograms per square metre (kg/m^2).



Region A = Underweight

Region B = OK

Region C = Overweight

Region D = Obese

Region E = Severely Obese

Activity 2.5: Body mass indices

1 Use the chart above to get a rough idea which BMI range the following people are in:

   a Masai 1.95 m tall, weighing 58 kg

   b Inuit (Eskimo) 1.56 m tall, weighing 70 kg

   c City office worker 1.75 m tall, weighing 85 kg

   d Unemployed male 1.82 m tall, weighing 138 kg

   e Construction worker 1.78 m tall, weighing 70 kg

   f Fashion model 1.77 m tall, weighing 52 kg

2 Now use the formula below to work out their exact BMI. Take the weight in kilograms (kg) and divide it by the height in metres (m) then divide whatever you get by the height again.

   Example

   a For a person 1.74m tall and weighing 82kg

   b BMI would be: 82 divided by 1.74, which gives 47.13

   c Divide this again by 1.74 and you get 27.08

   BMI ranges:

   Less than 18.5 Underweight

   18.5 to 24.9 Okay

   25 to 29.9 Overweight

   30 to 39.9 Obese

   Over 40 Severely obese

   So the BMI is about 27 kg/m^2, which puts the person in the 'overweight' range.

Suggestions for further work/homework

1 For each person listed above describe the environmental factors that might influence their weight.

2 Explain why some of the people above may be considered underweight or overweight yet they do in fact have a healthy BMI.

3 Calculate your own BMI. How does this compare with your other family members? Do you think your BMI is a result of your lifestyle, or is it inherited, or is it a result of both?

Activity 2.5: Body mass indices

Notes for teachers and technicians

Aim

In this activity students will calculate body mass indices to find the effect of environmental factors on weight.

Skills, knowledge and understanding

This activity will enable students to gain the following skills, and/or knowledge and understanding:

1 Body mass is an inherited characteristic that can be affected by environmental factors

2 How lifestyles, and environmental factors, can affect body mass.

Previous skills, knowledge and understanding required

- Basic arithmetic skills.
- Graph reading skills.

Materials required

Calculators.

Delivery strategies

This activity has been designed to make students aware of the influence of environmental factors, such as lifestyle, on body mass. Be aware that many students may be sensitive about their own weight. Question 3 in the suggestions for further work/homework may need to be modified for some groups.

Links with other GCSE Science topics

This activity is related to:

- B2 1.17 discuss why official advice on diet and exercise change over time and consider the scientific basis of current fashionable diets and advice
- B3 1.7 the importance of having a well-balanced diet
- B3 1.8 obesity may lead to a number of health problems.

Links with key stage 3 (KS3)

This activity builds on the following skills, knowledge and understanding from KS3:

- 9B Fit and Healthy.

Resources

www.diabetes.org.uk

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