Important Concepts . . .

Preview Review

Science Grade 9 TEACHER KEY

W3 - Lesson 3A: Genes and Cell Division

W3 - Lesson 3B: Organisms and Matter in their Environment

V5-07

Important Concepts of Grade 9 Science

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W1 - Lesson 2 ..... Electrical Circuits
W1 - Lesson 3A ..... Energy Consumption
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W3 - Lesson 5 ..... Transfer of Materials through the Air, Ground, and Water/Biological Impacts of Hazardous Chemicals
W3 - Quiz

Materials Required

Textbook:
Science in Action 9

Science Grade 9
Version 5
Preview/Review W3 - Lesson 3 TEACHER KEY

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Preview/Review Concepts
for
Grade Nine Science

TEACHER KEY

W3 - Lesson 3A:
Genes and Cell Division

OUTLINE

By the end of this lesson, you should

- explain chromosomes, genes, and DNA
- explain the difference between mitosis and meiosis

GLOSSARY

chromosome - a structure in which DNA is arranged and along which genes are located

DNA - deoxyribonucleic acid; genetic material found mainly in the nuclei of cells of living things

meiosis - a type of cell division that produces four sex cells from one parent cell; each sex cell contains half the genetic material of the original cell

mitosis - a type of cell division that produces two identical daughter cells from one parent cell

organelles - structure in cells that perform a cetain function

W3 - Lesson 3A: Genes and Cell Division

Do you ever get the comment that you look like or have the same traits as your mother or father? Family resemblance has to do with the genetic information found in your cells that has been passed from your mother and father. This lesson introduces genes, chromosomes, DNA, and cell division.

Cell Division

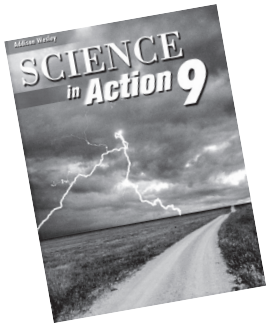
Humans are multicellular organisms. We are made of cells that are specialized and perform certain functions. Although our cells are specialized (i.e., skin cells), each cell contains the same genetic blueprint in its nucleus. Our cells are constantly undergoing cell division to grow and replace existing cells and tissue. For example, every three months we have a totally new red blood cell supply. This occurs by the process of mitosis.

Mitosis is an asexual reproductive process. One cell eventually forms two new cells that are identical to the parent cell. For this to happen, everything inside the cell (including all the cell organelles and chromosomes) must double in quantity. The cell then splits in two. In humans, mitosis repairs damage and increases the size of the body.

Humans are also capable of undergoing sexual reproduction by the process of meiosis. Remember that the main purpose of sexual reproduction is to produce variation in offspring. In humans, sperm and eggs are formed that contain half the genetic information of the cell.

Meiosis produces four cells with half the number of chromosomes from every parent cell. For this to happen, everything inside the cell (cell organelles and chromosomes) must double in quantity. Two cell divisions then follow. The gametes (egg and sperm) that are produced by meiosis are then able to join in the process of fertilization to produce a whole new different baby with the correct amount of genetic information.

Read pages 46-47 of *Science in Action 9*.



1. Identify two differences between mitosis and meiosis.

mitosis

- goes through cell division once -produces 2 cells

- daughter cells and parent cells have identical genetic material

meiosis

- goes through cell division twice - produces 4 cells

- daughter cells have half the genetic material of parent cells

2. If a human cell contains 46 chromosomes, how many chromosomes will a cell produced by mitosis contain? How many will a cell produced by meiosis have ?

mitosis ***46 chromosomes***

meiosis ***23 chromosomes***

3. Identify the main purpose of mitosis and meiosis in humans.

The main purpose of mitosis is for growth and replacement of cells.

The main purpose of meiosis is to produce gametes or sex cells (for variation in offspring).

DNA, Chromosomes, and Genes

Traits such as eye colour and curly hair are passed to children from their parents. This information is carried by the genetic blueprint they receive when the egg and sperm, produced by meiosis, unite. What is that genetic blueprint and where is it found?

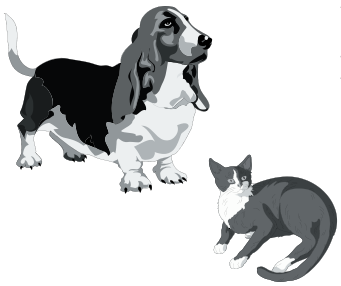
Our genetic blueprint is basically a set of instructions. The instructions are written in code in the form of **DNA**. DNA stands for deoxyribonucleic acid. It is found in the nucleus of almost every cell in a body.

We can compare the structure of DNA to a twisted ladder. The sides of the ladder are alternating deoxyribose sugar and phosphate groups. The rungs of the ladder are sequences of nitrogen bases that are paired. The nitrogen bases that make up the rungs are adenine, guanine, cytosine, and thymine. Adenine (A) always pairs with thymine (T). Cytosine (C) always pairs with guanine (G).

Look at Figure 3.4 on page 41 of *Science in Action 9*. DNA in your cells is estimated to be made up of 26 million nitrogen base pairs. The various combinations of these base pairs is what makes you!

Because DNA is such a long complex molecule, it does not fit into the nucleus of your cells in the form that it is in. **Chromosomes** are DNA that is wound around proteins. Chromosomes in humans basically resemble an X shape. Look at Figure 3.6 on page 43 in *Science in Action 9* to see a picture of a chromosome.

One of the things that scientists have found, with the help of microscopes is that chromosomes have banding patterns. These banding patterns are called genes. A **gene** is a segment of DNA that contains coded instructions for the production of a person's traits. For example, one gene codes for a person's skin colour. You need to remember that genes (like chromosomes) are found in pairs. In humans, one gene for a specific trait (such as hair colour) comes from the father and one comes from the mother. The interaction of the two genes produces hair colour. An **allele** is one of the possible forms of a gene that exist for a specific trait.



Read pages 39-45 of *Science in Action 9*.

4. Humans have 46 chromosomes that are basically 23 pairs. How many chromosomes do dogs and cats have?

   Dogs have 78 chromosomes or 39 pairs.

   Cats have 38 chromosomes or 19 pairs.

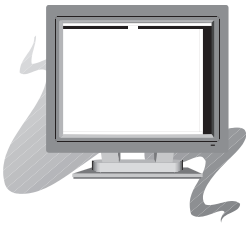
5. How long would a DNA molecule be if it was stretched out? With this information, explain why it is important that DNA is wound into chromosomes.

Each DNA molecule would stretch out to a length of two metres. At this length, DNA would not physically fit inside a cell's nucleus.

6. Humans have 46 chromosomes in their cells. Sometimes, mistakes occur during meiosis and a person can have 47 chromosomes. If our genetic blueprint (our set of instructions) is found on 46 chromosomes, what do you think is the effect of adding one more chromosome to a cell?

Adding more instructions creates problems in the new individual. Their genetic blueprint is different than in a human with 46 chromosomes.

Websites

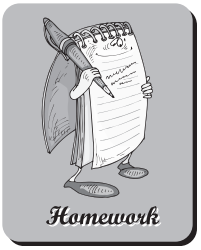


The addresses for the websites below were valid at the time of printing.

http://www.icnet.uk/kids/cellsrus/cellsrus.html

http://www.cellsalive.com/mitosis.htm

Homework



7. Do some research on the genetic disorder *Down's syndrome*. How many chromosomes does a person with Down's syndrome have? What are some symptoms of this syndrome?

A person with Down's syndrome has 47 chromosomes in each cell (three chormosome 21's). Some symptoms of this syndrome are a flattened forehead, poor muscle development, stubby hands, a large tongue, and an extra fold of skin on the eyelids. Also, these individuals are mentally challenged.

Preview/Review Concepts for Grade Nine Science

TEACHER KEY

W3 - Lesson 3B:
Organisms and Matter in their Environment

OUTLINE

By the end of this lesson, you should

- explain the difference between organic and inorganic compounds
- identify the compounds that are necessary for the growth of organisms
- identify and describe the different types of nutrients
- identify how nutrient compounds are taken into organisms

GLOSSARY

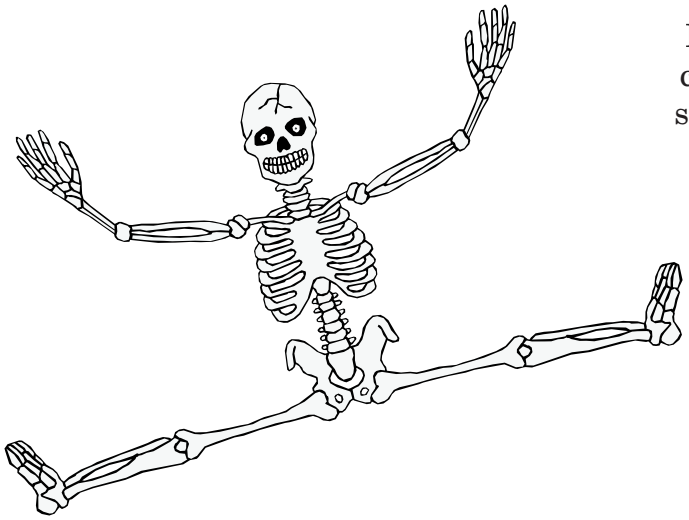
active transport - process in which plant and animal cells use energy to move nutrient molecules from areas of lower concentration to areas of higher concentration

carbohydrates - organic molecules made of atoms of carbon, hydrogen, and oxygen; can form simple molecules such as sugar, or large complex molecules such as starch, cellulose, and glycogen

ingestion - process by which food is taken into a body

macronutrients - nutrients that organisms need in relatively large amounts

W3 - Lesson 3B: Organisms and Matter in their Environment



Did you know that your bones need calcium, phosphorus, and magnesium to be solid and healthy? These elements are part of inorganic and organic compounds in our environment. This lesson looks at the lessons we need these elements in our body and how we take them into our body.

Macronutrients

All organisms need certain nutrients to live and maintain their body structures. Humans are no different. We need a combination of inorganic and organic compounds to survive.

An **organic compound** is a complex molecule that contains carbon. An example is glucose ($C_6H_{12}O_6$), which is required for the process of cellular respiration in our bodies.

An **inorganic compound** is a simpler molecule that usually does not contain carbon. Oxygen (O_2) is inorganic and necessary for the process of cellular respiration as well.

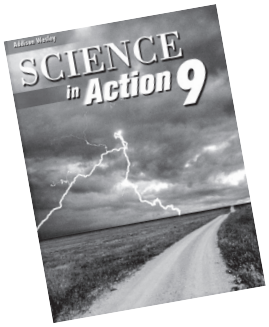
A **macronutrient** is a nutrient that an organism needs in large amounts. Here are some examples of macronutrients we need in our bodies.

Nitrogen (N) is a component of proteins and DNA found in all cells.

Phosphorus (P) is a component of bones, teeth, and DNA.

Potassium (K) is needed for muscle contraction and nerve impulse.

Calcium (Ca) is needed for blood clotting and the building of bones and teeth.



Read pages 196-198 of *Science in Action 9*.

1. A macronutrient is a nutrient that an organism needs in large amounts. What is a micronutrient? Give an example.

   A micronutrient is a nutrient that is needed in only small amounts. For example – selenium.

2. Why do plants need phosphorus and calcium?

   phosphorus ***Plants need phosphorus for root and flower growth, cellular respiration, and photosynthesis. It is also needed for cell-wall structure and cell division.***

   calcium ***Plants need calcium for cell division and cell-wall structure***

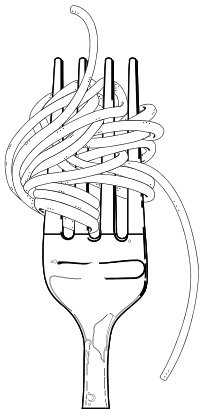
3. Give an example of an organic and inorganic compound not previously mentioned.

   organic ***natural gas or coal***

   inorganic ***baking soda or quartz***

Types of Organic Molecules

Plants and animals require certain nutrients to live. They can either produce the nutrients themselves or take in the nutrients from another source. The four main classes of nutrients are carbohydrates, lipids, proteins, and nucleic acids.



Carbohydrates are complex organic molecules needed in humans to provide a source of energy. An example of a carbohydrate is spaghetti. Carbohydrates break down in the human body into glucose, which is necessary for the process of cellular respiration. Plants are the only organisms capable of producing carbohydrates through the process of photosynthesis.

Lipids are basically fats, oils, and waxes. Lipids are necessary for the structure of cell membranes. Both plants and animals produce lipids. Peanuts contain large amounts of oil.

Proteins are the building blocks of all cells and tissues. Proteins are made of individual amino acids joined together. We can obtain proteins from both plant (for example, nuts) and animal (for example, meat) sources.

Nucleic acids are necessary for the genetic blueprint of an organism. There are two kinds of nucleic acids: DNA and RNA. DNA stores the genetic code for an organism in the nucleus of a cell whereas RNA (ribonucleic acid) is necessary to make proteins. We obtain nucleic acids from plant and animal foods.

Read pages 199-203 of *Science in Action 9*.

4. Classify the following substances by identifying the main nutrient they contain.

   a. rice ***carbohydrate***

   b. butter ***lipid***

   c. RNA ***nucleic acid***

   d. fish ***protein***

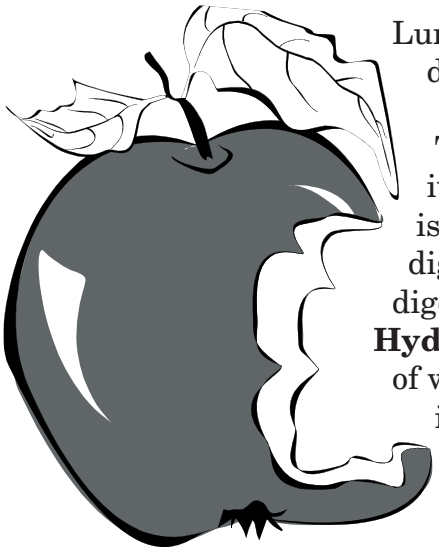
   e. corn ***carbohydrate***

   f. eggs ***protein***

5. Identify and explain a component of the human body that forms proteins.

   An enzyme is made up of proteins. An enzyme is a catalyst that controls the rate of chemical reactions within the body.

How Organisms take in Substances



Lunchtime! I have an apple as part of my lunch today. How does the food that is required for our body get to our cells?

The first step in this process is to eat the apple or **ingest** it. The apple then travels through our digestive system and is broken into tiny units (in this case, glucose). Mechanical digestion breaks the apple with our teeth. Chemical digestion, with the help of **enzymes**, causes hydrolysis. **Hydrolysis** occurs by breaking substances further with the use of water (H_2O). The smallest units of food are then absorbed into our bloodstream where they are carried to individual cells.

Small substances can enter cells in three ways. The processes are diffusion, osmosis, and active transport.

Diffusion is the movement of molecules from an area of **high** concentration to an area of **low** concentration. No extra energy is required for this movement.

Osmosis is the movement of water molecules from a **high** concentration to a **low** concentration. No extra energy is required for this movement.

Active Transport is the movement of molecules from a **low** concentration to a **high** concentration. This process requires a carrier molecule and the addition of energy.

Read pages 204-206 of *Science in Action 9*.

6. Give an example of a substance that a plant actively transports into itself.

   nitrogen, phosphorus, sulfur, potassium

7. Identify a substance that moves into cells by diffusion.

   oxygen

8. What are two differences between osmosis and active transport?

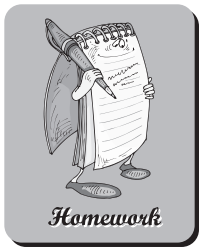
   Osmosis moves molecules from a high concentration to a low concentration and it does not require the addition of energy.

   Active transport moves molecules from a low concentration to a high concentration and requires the addition of energy.

Internet Websites

The address for the website below was valid at the time of printing.

http://kidshealth.org/kid/stay_healthy/food/protein_carb_fat.html



Homework

9. Place a drop of food colour into a glass of water. Describe what happens. This is an example of diffusion bringing materials into your cells.

The color slowly moves throughout the glass until the water is all the same colour (uniform.)

10. Here is a second small experiment. Fill a tall clear glass half full with water. Add 1 tablespoon of red or blue food colour into the glass. Place a celery stalk (with leaves) in the water. Leave the experiment for 24 hours. Describe your results. What type of transport do you think is occurring in the celery stalk?

The red or blue food colouring will travel all the way up the celery stalk. Osmosis brings water into and up the celery stalk.