

TEACHERS' NOTES
WORKSHEET 1
An introduction to human genetics

Suggested Year Level:

- K – 2

Curriculum Advice:

- Living Things: knowledge and understanding – **Stage 1**.
Understanding and recognising the fact that all living things are different.

Learning Objective:

- To understand that each person is different and special because of his/her genes and the environment in which they live (the food they eat, the air they breathe etc).

Background:

- Genes are the instructions in our bodies that make us grow and help our bodies work.
- The genes also contain the information for how we look: the colour of our hair, the shape of our nose etc.
- We get half our genes from Mum and the other half of our genes from Dad.

Instructions for the Activity:

- Read the poem together
- The students write their name at the top of the sheet and draw a picture of themselves. Take time to discuss the differences between people such as hair and eye colour, curly and straight hair etc. Encourage them to draw these features in their picture of themselves as appropriate.

Resources:

- www.genetics.com.au
- <http://www.genecrc.org/site/ko/ko5.htm>

References and Sources:

- Adapted from the Murdoch Institute Education Unit – Goals for Genes, 1999.
- Barlow-Stewart, K. (Ed.) 2004. Genetics Resource Book, Seventh Edition. Centre for Genetics Education, Royal North Shore Hospital, Sydney.

TEACHERS' NOTES
WORKSHEET 2

Thinking about similarities and differences

Suggested Year Level:

- K - 2

Curriculum Advice:

- Living Things: knowledge and understanding – **Stage 1**.
All things are different.

Learning Objective:

- To recognise that people can differ with respect to certain physical traits/characteristics

Instructions for Activity:

- Ask the students to fill in what colour eyes they have, what type of hair they have and whether or not they have a hitchhiker's thumb.

Background:

- Eye colour is a special case. It is not a simple case of brown eyes being dominant over blue as is widely thought. Two parents with blue eyes can have brown-eyed children. It seems that eye colour is determined by a few major genes interacting with each other.
- Hair colour is an example of a simple hereditary trait – multiple genes and environmental factors contribute to hair colour in humans.

Resources:

- www.genetics.com.au
- <http://www.genecrc.org/site/ko/ko5.htm>

References and Sources:

- Adapted from the Murdoch Institute Education Unit – Goals for Genes, 1999.
- Barlow-Stewart, K. (Ed.) 2004. Genetics Resource Book, Seventh Edition. Centre for Genetics Education, Royal North Shore Hospital, Sydney.
- Pierce, Benjamin A. (1990). The Family Genetic Sourcebook. John Wiley and Sons, Inc, pp212, pp221.

TEACHERS' NOTES
WORKSHEET 3
Fill in the gap

Suggested Year Level:

- Years 3 - 4

Curriculum Advice:

- Living things: knowledge and understanding – **Stage 2**.
Living things show variation within a species.

Learning Objective:

- To introduce some basic terms about genes and the environment to students' vocabularies so that they may begin to familiarise themselves with commonly used words and their meanings and feel comfortable using them.

Background:

- Each person is unique – there are no two people exactly alike. Even twins have some differences.
- Some of the differences between people are due to genetics. Genetics is what makes people similar to their Mums and Dads and to other family members. Genetics is about families.
- Other differences are due to the environment in which the person lives (the food they eat, the air they breathe etc).
- Half of our genes come from Mum and the other half of our genes come from Dad.
- Each person is a different mixture of the genes from their parents. That is why brothers and sisters are not identical.
- The instructions for building each person are held in the genes. These are what determine what colour our hair will be or whether or not we can roll our tongue and what contribute to how tall we will grow etc.

NOTE: Do not use eye colour as an example as the inheritance of the genes involved is complex – eg two blue-eyed parents can have a brown-eyed child. There are around 6 genes involved in determining eye colour.

- We inherit these genes from our parents.
- Our bodies are made of millions of tiny units called cells. There are different types of cells for different parts of the body such as skin cells, bone cells, heart cells etc. Our genes are found inside these cells.
- Genes are made of a chemical called **d**eoxyribo**n**ucleic **a**cid – DNA.

Instructions for Activity:

- Conduct a general discussion with the class about genetics and the environment, introducing all of the terms that are a part of the fill-in-the-gap exercise. Afterwards, have the students fill in the gaps on their worksheets to give them the opportunity to demonstrate how much they have understood.
- Discuss some traits that we inherit from our parents.

Answers:

1. different
2. information
3. genes
4. food we eat
5. inherit

6. genes
7. DNA

Resources:

- www.genetics.com.au
- <http://www.genecrc.org/site/ko/ko5.htm>

References and Sources:

- Adapted from the Murdoch Institute Education Unit – Goals for Genes, 1999.
- Barlow-Stewart, K. (Ed.) 2004. Genetics Resource Book, Seventh Edition. Centre for Genetics Education, Royal North Shore Hospital, Sydney.

TEACHERS' NOTES
WORKSHEET 4

Class tally – Do you have a hitchhiker's thumb?

Suggested Year Level:

- Years 3 - 4

Curriculum Advice:

- Living Things: knowledge and understanding – learning processes. **Stage 2.**
Recognise that discoveries can be made through play, exploring and experimenting
Recognise that the results of investigations can lead to more questions

Learning Objective:

- To understand that there are differences and similarities among people and within families using whether or not students have a hitchhiker's thumb as an example.

Background:

- Some people can hyperextend the last joint of their thumb and others cannot. This is solely due to genetics. The environment plays no role in this characteristic.

Instructions for Activity:

- Ask all the students to practise and see whether they have a hitchhiker's thumb or not.
- Count the number of students who do have a hitchhiker's thumb and the number who don't and keep a record of the tally appropriately in the table provided.
- Discuss the results –
 - Is everyone the same?
 - Which is more common in your class?
 - Do you think this chart would look the same if we counted all the students in the whole school?
 - As a result of the discussion, students should have discovered that there are both differences and similarities among people, just as there are within the class.

Resources:

- www.genetics.com.au
- <http://www.genecrc.org/site/ko/ko5.htm>

References and Sources:

- Adapted from the Murdoch Institute Education Unit – Goals for Genes, 1999.
- Barlow-Stewart, K. (Ed.) 2004. Genetics Resource Book, Seventh Edition. Centre for Genetics Education, Royal North Shore Hospital, Sydney.

TEACHERS' NOTES
WORKSHEET 5
Word Find

Suggested Year Level:

- Years 3 - 4

Curriculum Advice:

- Living Things: knowledge and understanding – **Stage 2**.

Learning Objective:

- To reinforce the basic terms and concepts of genes inherited from parents.

Instructions for Activity:

- Discuss the meaning of each of the words listed and then students will find each hidden word in the puzzle.

Answers:

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Z | T | O | C | G | E | N | E | T | I | C | S | I |
| B | O | D | Y | E | M | L | O | V | N | X | Z | N |
| V | R | U | D | N | M | B | C | Z | H | R | T | F |
| R | S | T | O | E | S | M | E | V | E | H | T | O |
| O | V | A | E | S | C | L | O | P | R | P | Q | R |
| Q | D | A | D | Z | E | B | M | E | I | F | N | M |
| B | R | B | E | I | L | N | O | I | T | Z | E | A |
| C | R | I | G | N | L | D | E | Z | U | R | R | T |
| S | I | M | I | L | A | R | N | O | V | B | T | I |
| T | U | V | D | E | O | P | I | A | L | M | O | O |
| P | M | L | U | B | Z | Z | O | P | R | F | H | N |
| Z | E | U | L | E | U | P | M | Z | Z | L | P | X |
| N | E | C | M | K | K | V | L | O | P | R | I | U |
| D | B | L | V | U | E | T | P | F | J | G | C | C |
| V | M | I | O | D | I | F | F | E | R | E | N | T |
| R | L | Y | I | K | X | X | U | B | R | G | Y | L |

Some Definitions:

1. **Cell** – the basic structural unit of all living organisms. Humans are made up of millions of cells. Each cell is enclosed by a membrane and has a nucleus which contains the genetic material (DNA) in the form of chromosomes.
2. **DNA** (Deoxyribonucleic Acid) - The chemical compound which makes up genes within chromosomes and is the basic material of heredity. It is made up of chemicals called nucleotide bases, linked together in a chain. Two chains of nucleotides twist around each other to form a double helix.
3. **Genes**: The basic units of heredity; a gene is a segment of DNA which contains the information for a specific characteristic or function.
4. **Genetics**: the science of heredity.
5. **Inherit**: The transmission of genetic information from a parent to a child.

Resources:

- ❑ www.genetics.com.au
- ❑ <http://www.genecrc.org/site/ko/ko5.htm>

References and Sources:

- ❑ Adapted from the Murdoch Institute Education Unit – Goals for Genes, 1999.
- ❑ Barlow-Stewart, K. (Ed.) 2004. Genetics Resource Book, Seventh Edition. Centre for Genetics Education, Royal North Shore Hospital, Sydney.

TEACHERS' NOTES
WORKSHEET 6
Let's get creative!

Suggested Year Level:

- ☐ Years 3 - 4

Curriculum Advice:

- ☐ Living Things: knowledge and understanding – **Stage 2**.

Learning Objective:

- ☐ To demonstrate understanding of terms used in genetics through poetry.

Instructions for Activity:

- ☐ Discuss once again the various terms encountered in this genetics unit and ask the students to complete the acrostic poem using the letters of the words “DNA” and “GENES” as the first letter of each sentence to construct a poem.
- ☐ It does not have to rhyme.

Resources:

- ☐ www.genetics.com.au
- ☐ <http://www.genecrc.org/site/ko/ko5.htm>

References and Sources:

- ☐ Adapted from the Murdoch Institute Education Unit – Goals for Genes, 1999.
- ☐ Barlow-Stewart, K. (Ed.) 2004. Genetics Resource Book, Seventh Edition. Centre for Genetics Education, Royal North Shore Hospital, Sydney.

TEACHERS' NOTES
WORKSHEET 7
Yes/No exercise

Suggested Year Level:

- Years 3 – 4

Curriculum Advice:

- Living Things: knowledge and understanding – **Stage 2**.

Learning Objective:

- To show understanding of terms used in genetics presented to students and that they are comfortable using them.

Instructions for Activity:

- Ask students to complete the exercise by answering yes or no to the statements appropriately.

Answers:

1. Yes
2. Yes
3. Yes
4. Yes
5. No
6. Yes

Resources:

- www.genetics.com.au
- <http://www.genecrc.org/site/ko/ko5.htm>

References and Sources:

- Adapted from the Murdoch Institute Education Unit – Goals for Genes, 1999.
- Barlow-Stewart, K. (Ed.) 2004. Genetics Resource Book, Seventh Edition. Centre for Genetics Education, Royal North Shore Hospital, Sydney.

TEACHERS' NOTES
WORKSHEETS 8 AND 9 – BACKGROUND INFORMATION
Fill in the gap

Suggested Year Level:

Years 5 – 6

Curriculum Advice:

Living Things: knowledge and understanding – **Stage 3**.

Learning Objective:

- To extend students' knowledge one step further in genetics by introducing new terms and concepts such as chromosomes and double helix and giving them meaning. Students have the opportunity to integrate previous knowledge gained with new terms and form meaningful relationships between them.

Background:

- Cells could be described as the many tiny building blocks that make a person. They are so tiny that you could fit hundreds of them on a point of a pin. There are different types of cells in different parts of the body – eg skin cells, blood cells, bone cells etc
- Lots of things go on inside the cell. One of the important processes that occurs in the cell is the building of more cells so that we can grow. The instructions for this building process are found within the nucleus of the cell. The nucleus is like the control centre of the cell.
- Inside the nucleus are lots of long structures called chromosomes. These are made of long strands coiled up like a telephone cord. There are 23 pairs of these chromosomes, making 46 all together. Of these, 23 come from the egg from mum and 23 from dad's sperm. At conception, the egg and sperm fuse to form the first cell of the baby. This cell has 46 chromosomes (23 pairs) – which is all the genetic information required for a new person to begin to develop¹. One chromosome is like a string of beads.
- A chromosome is made of 2 DNA chains which resemble a twisting, twirling ladder. This shape is known as a double helix.

Instructions for Activity:

- Initiate a class discussion with a focus on understanding what has been learnt previously in terms of genetics.
- As students start to think about key terms, gradually begin to introduce these new terms and outline how they fit in.

Answers:

1. inherit
2. chromosomes
3. cell
4. millions, building blocks
5. pairs
6. double helix

Resources:

- www.genetics.com.au
- <http://www.genecrc.org/site/ko/ko5.htm>
- Genetics Resource Book, Seventh Edition. 2004-2005. Centre for Genetics Education.

References and Sources:

- ❑ Adapted from the Murdoch Institute Education Unit – Goals for Genes, 1999.
- ❑ Barlow-Stewart, K. (Ed.) 2004. Genetics Resource Book, Seventh Edition. Centre for Genetics Education, Royal North Shore Hospital, Sydney.

TEACHERS' NOTES
WORKSHEETS 8 AND 9 – BACKGROUND INFORMATION
Take a closer look

Suggested Year Level:

- Years 5 – 6

Curriculum Advice:

- Living Things: knowledge and understanding – Stage 3.

Recognising that the results of investigations can lead to more questions and making predictions based on previous experiences.

Learning Objective:

- To discover where DNA is found in a person.

Background:

- Each of us is **unique** Reinforce the concept of differences and similarities between individuals and the fact that many of these features are due to the genes in their bodies. Others are due to their environment.
- Each person is made of millions of **cells** Cells are the tiny building blocks that make a person. Each cell contains a complete copy of a person's genetic plan.
- Inside each cell is one **nucleus** Lots of things go on inside the cell. One of the important processes that occurs in the cell is the building of more cells so that we can grow. The instructions for this building process are found within the nucleus of the cell.
- And in each nucleus there are 46 **chromosomes** Inside the nucleus are lots of long structures called chromosomes. These are made of long strands coiled up like a telephone cord. There are 23 pairs of these chromosomes, making 46 all together. One chromosome is like a string of beads.
- Along the chromosomes are areas called **genes** The chromosomes are the structures that contain the instructions to make cells. There is a set of instructions to make every single part of our body. Each set of instructions has its own place on a chromosome. This part of a chromosome is called a gene.

Instructions for Activity:

- This could be done as a class activity, by discussing the paragraph below each statement and then asking the students to fill in the blank from the words at the bottom of the sheet. This will test comprehension of the concept. A good analogy to use to start the discussion is that a person's genetics makeup is like a library of books. The library is the body. The library contains two copies of 20 000 different books (ie 40 000). Each book contains the instructions or recipe for a particular task. The words in the books are made up of the letters ATCG and each word is three letters long. Sometimes the books will have chapters or pages missing or misspelt words. These mistakes or changes are called mutations and may cause genetic disorders.

Answers:

1. unique
2. cells
3. nucleus
4. chromosomes
5. genes

Resources:

- www.genetics.com.au

- <http://www.genecrc.org/site/ko/ko5.htm>

References and Sources:

- Adapted from the Murdoch Institute Education Unit – Goals for Genes, 1999.
- Barlow-Stewart, K. (Ed.) 2004. Genetics Resource Book, Seventh Edition. Centre for Genetics Education, Royal North Shore Hospital, Sydney.

TEACHERS' NOTES
WORKSHEET 10
Boy or girl?

Suggested Year Level:

- Years 5 – 6

Curriculum Advice:

- Living things: knowledge and understanding – Stage 3.

Learning Objective:

- To discover the difference between male and female at the cellular level.

Background:

- Just like the cells shown here, every cell in our body has 46 chromosomes. The exception to this is our sex cells – the egg and the sperm: these only have 23 chromosomes each, so that when they meet and join they make a perfect 46 in the small cell that begins life. As this cell divides, the chromosomes replicate (make copies of themselves) and divide too so that all of our billions of cells contain replicas of those same 46 chromosomes. The pairs of chromosomes are numbered 1 to 22, with the 23rd pair called the **sex chromosomes**, being named X and Y. Females have two X chromosomes, while males have an X and a Y.

Instructions for Activity:

- Ask the students to look at the two cells and identify each pair of chromosomes – so look for the two number 1 chromosomes, then the two number 2 chromosomes and so on, colouring each pair up to number 22.
- After the 22 pairs have been coloured, there will be two chromosomes left.
- If there are two X chromosomes, the cell is female and if there is an X and a Y chromosome left, the cell is male.

Answers:

- The cell on the **left** is **female** – **XX**
- The cell on the **right** is **male** – **XY**

Resources:

- www.genetics.com.au
- <http://www.genecrc.org/site/ko/ko5.htm>

References and Sources:

- Adapted from the Murdoch Institute Education Unit – Goals for Genes, 1999.
- Barlow-Stewart, K. (Ed.) 2004. Genetics Resource Book, Seventh Edition. Centre for Genetics Education, Royal North Shore Hospital, Sydney.

TEACHERS' NOTES
WORKSHEET 11
Human Genes

Suggested Year Level:

- Years 4 – 5

Curriculum Advice:

- Living Things: knowledge and understanding – Stage 2.

Learning Objective:

- To recognise the fact that all living things share DNA and genes in common – they are not unique to humans. To understand that what makes living organisms different from one another is the information that is in the genes.

Background:

- It is important to stress the fact that the aim of this set of worksheets is to focus on **human genetics**. Students need to be able to recognise that genes exist within all living things. Therefore, just as we can study human genetics, we can also study plant and animal genetics. Humans look the way they do because of the number of genes they have and because of the type of information in their genes. The information in human genes gives all the instructions for making a human and this information is different to that of plant genes and animal genes which gives the instructions for making a plant and animal grow and work respectively.

Instructions for Activity:

- Open a class discussion encouraging students to think about the differences between plants, animals and humans. Explain that all living things have cells (defined in previous worksheets) so all plants, animals and humans have cells. All plants, animals and humans have genes made up of DNA within their cells. Despite that, however, plants look different to animals which in turn look different to humans. Ask students to think about why that would be. Focus the discussion on the type of information in the genes. The information in human genes is different to the information in plant and animal genes. The numbers of genes in humans is also different to the number of genes in different plants and animals. That is why living things look different.
- Give students the opportunity to complete the exercise. Discuss the answers.
- Ask the students to look at the second page of Worksheet 11 and understand that different living things have different numbers of genes and so look different.
- An interesting point to make is that worms have almost the same number of genes as humans and yet look completely different and are significantly smaller. This emphasises the importance of the type of information within the genes.

Answers:

1. animals
2. cells
3. genes
4. plants
5. information
6. work
7. DNA
8. humans
9. tomato
10. number
11. type of information

Resources:

- www.genetics.com.au
- <http://www.genecrc.org/site/ko/ko5.htm>

References and Sources:

- Adapted from the Murdoch Institute Education Unit – Goals for Genes, 1999.
- Barlow-Stewart, K. (Ed.) 2004. Genetics Resource Book, Seventh Edition. Centre for Genetics Education, Royal North Shore Hospital, Sydney.

TEACHERS' NOTES
WORKSHEET 12
Extension exercise 1: cracking the code

Suggested Year Level:

- Year 6

Curriculum Advice:

- Living things: knowledge and understanding – Stage 3.

Learning Objective:

- To further extend knowledge and understanding of DNA.

Background:

- Chromosomes are made of long chains of a chemical called DNA The long strands that make the chromosomes are actually long chemicals. Together, the two strands resemble a twisted rope ladder – this twisting shape is called a double helix. The name of the chemical is **d**eoxyribo**n**ucleic **a**cid and is abbreviated to DNA.
- DNA is made from four building blocks called 'bases' DNA is a very long chemical made up of four building blocks called Adenine, Thymine, Cytosine and Guanine (shortened to A, T, C and G respectively). These four letters spell the instructions for making new cells of every different type in our body

By the end of this description, the students should have some concept of DNA as the basis of genes, which make us individuals.

Instructions for Activity:

- Ask students to complete the exercise using the words from the list.

Answers:

- I. DNA
- II. bases
- III. adenine
- IV. cytosine
- V. guanine
- VI. thymine

Resources:

- www.genetics.com.au
- <http://www.genecrc.org/site/ko/ko5.htm>
- Genetics Resource Book, Seventh Edition. 2004-2005. Centre for Genetics Education.

References and Sources:

- Adapted from the Murdoch Institute Education Unit – Goals for Genes, 1999.
- Barlow-Stewart, K. (Ed.) 2004. Genetics Resource Book, Seventh Edition. Centre for Genetics Education, Royal North Shore Hospital, Sydney.

TEACHERS' NOTES
WORKSHEET 13
Extension exercise 2: finding our genes

Suggested Year Level:

- Year 6

Curriculum Advice:

- Living Things: knowledge and understanding – Stage 3.

Learning Objective:

- To integrate knowledge learned thus far with graphical support.

Instructions for Activity:

- Students cut out the squares on page 1 of the exercise and arrange them in order of largest to smallest object to paste in the appropriate spaces on page 2.

Answers:

- I. Person
- II. Cell
- III. Chromosome
- IV. DNA
- V. Genes
- VI. Combination of chemicals

Resources:

- www.genetics.com.au
- <http://www.genecrc.org/site/ko/ko5.htm>

References and Sources:

- Adapted from the Murdoch Institute Education Unit – Goals for Genes, 1999.
- Barlow-Stewart, K. (Ed.) 2004. Genetics Resource Book, Seventh Edition. Centre for Genetics Education, Royal North Shore Hospital, Sydney.