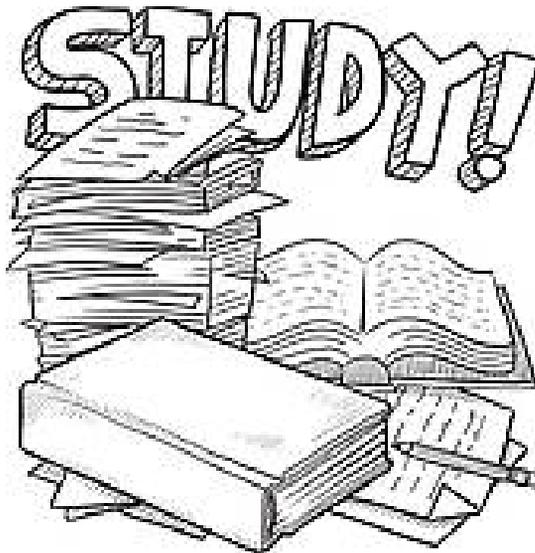


SCIENCE 10

FINAL EXAM REVIEW BOOK 2



DNA IS THE FOUNDATION FOR THE UNITY AND DIVERSITY OF LIVING THINGS

NAME: _____

BLOCK: _____

Unit 2: Biology - DNA, Genetics & Evolution

use this page to make your own KEY summary notes

Biology Summary

ESSENTIAL QUESTION How is DNA the foundation for unity and diversity of living things?

TOPIC 1.1:

How does an understanding of DNA help us investigate living things?

- The variation in living things we see around us is due to DNA.
- DNA is made of many nucleotides linked together in a specific order.
- DNA exists in chromosomes, which contain thousands of genes.
- The structure of DNA is important to passing on genetic information.
- The different genetic make-up of organisms is reflected in the diversity of life.

Key Terms

DNA	nucleotide
protein	chromatin
chromosome	gene
allele	karyotype
species	population
nitrogenous bases	
complementary bases	
homologous chromosome	



TOPIC 1.2:

How is hereditary information passed from one generation to the next?

- Genes pass on inherited traits from parent to offspring.
- Punnett squares show the probability of offspring inheriting specific traits.
- Both alleles are expressed in codominance.
- In incomplete dominance, alleles are neither dominant nor recessive.
- Some inherited traits are due to alleles on the sex chromosomes.

Key Terms

genetics	traits	dominant
recessive	phenotype	genotype
homozygous	heterozygous	codominance
incomplete dominance		sex-linked traits



TOPIC 1.3:

How can natural and artificial selection influence changes in populations?

- DNA mutations produce genetic diversity within a population.
- Natural selection favours traits that make an organism better suited to its environment.
- Natural selection can lead to the formation of new species.
- Environmental factors can cause mutations.
- Humans select desired characteristics in organisms to be passed on to the next generation.

Key Terms

mutation	selective advantage	natural selection
adaptation	adaptive radiation	extinction
mutagen	carcinogen	artificial selection
monoculture		

TOPIC 1.4:

How and why are the genes of organisms manipulated?

- DNA of a living cell can be copied, modified, and inserted into another organism.
- DNA technology has many uses.
- The use of biotechnology has some risks and raises some ethical issues.

Key Terms

biotechnology	cloning
gene cloning	recombinant DNA
artificial insemination	in vitro fertilization (IVF)
gene therapy	

Intro to Genetics & DNA

QP Questioning and Predicting PC Planning and Conducting PA Processing and Analyzing E Evaluating
AI Applying and Innovating C Communicating

Understanding Key Ideas

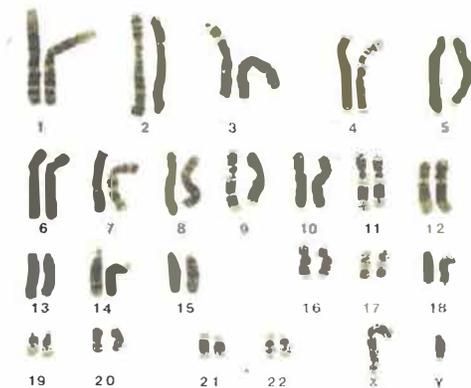
1. Think about a time you have seen a flock of Canada geese flying overhead. If you could examine the geese closely, would they look identical? Would they be genetically identical? Explain your answers. **PA C**
2. Describe the structure of DNA. **C**
3. What is the role of DNA in cells? **C**
4. Suppose a section of DNA has 27 percent thymine (T). **PA**
 - a) What percentage of cytosine (C) does it have?
 - b) What percentage of adenine (A) does it have?
 - c) What percentage of guanine (G) does it have?
5. What is a genome? **PA**
6. Using a diagram or flowchart, illustrate the relationships among nucleotide, DNA, gene, allele, chromatin, and chromosome. **C**
7. Why is the word *homologous* used to describe chromosome pairs, rather than the word *identical*? **PA**
8. How are homologous chromosomes alike? How are they different? Make a diagram to help explain your answer. **PA C**
9. Draw and label a karyotype for an organism that has three pairs of homologous chromosomes. **PA C**
10. Why are the X and Y chromosomes commonly referred to as the sex chromosomes? **PA**
11. How does DNA replication ensure that daughter cells can produce the same proteins? **PA**

Connecting Ideas

12. Use a graphic organizer to show the relationships among the terms *biodiversity*, *genetic diversity*, *species diversity*, and *ecosystem diversity*. **PA C**
13. What is the difference between a gene and an allele? How is each related to diversity among living things? **PA**

Making New Connections

14. The human genome contains about 3.0×10^9 pairs of bases. Humans have approximately 21 000 genes, and a typical gene has 3000 base pairs. Suppose that the genome is a railway track and each base pair is a railway tie. If each railway tie is 1 m from the next, how many kilometres long is the track? Given this information, how much of the human genome consists of DNA that does not code for proteins? **AI**
15. The image below shows chromosomes in a human cell. **PA**
 - a) What is this representation called and how is it prepared?
 - b) Identify the sex of the individual.
 - c) Does this individual have the correct number of chromosomes? How do you know?

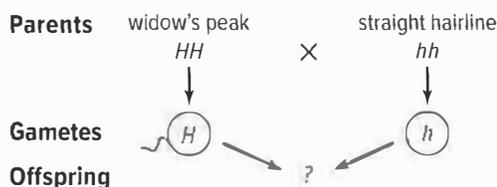


Genes & Inheritance

Questioning and Predicting Planning and Conducting Processing and Analyzing Evaluating
Applying and Innovating Communicating

Understanding Key Ideas

1. Explain how Mendel used selective breeding to learn more about heredity.
2. In terms of experimental design, why was it important that Mendel used true-breeding plants to explore patterns of inheritance?
3. Explain the differences between the following sets of terms and give an example of each term:
 - a) dominant and recessive
 - b) genotype and phenotype
 - c) homozygous and heterozygous
4. The diagram below represents the genotypes of two parents and one gamete from each parent.



- a) What is the genotype of the offspring?
 - b) What is the phenotype of the offspring? Explain your reasoning.
5. Suppose that two siblings both have attached earlobes, and their parents have unattached earlobes. Unattached earlobes are represented as E , and attached earlobes are represented by e . What are the genotypes of the parents? Explain your reasoning.

6. Copy the Punnett square into your notebook. The ability of a person to roll his or her tongue is dominant (T), and the inability is recessive (t).

	T	t
t	Tt	
t	Tt	

Fill in the blank genotypes and describe the phenotypes for each.

7. In pigeons, the checker pattern of feathers (F) is dominant to the non-checker pattern (f). Suppose a checkered pigeon with the genotype Ff mates with a non-checkered pigeon. Draw a Punnett square to predict the genotypes of their offspring.
8. A white-flowered plant is crossed with a red-flowered plant. What is the likely mode of inheritance if the offspring produced are
 - a) plants with pink flowers?
 - b) plants with red flowers?
9. How does sex-linked inheritance occur?

Connecting Ideas

10. The Punnett square shows the genotype of the female parent and the genotypes of the offspring.

	?	?
X^b	X^bX^b	X^bY
X^b	X^bX^b	X^bY

X^B = Normal

X^b = Red-green colour vision deficiency

Y = Y chromosome

- a) What is the genotype of the male parent?
- b) What is the phenotype of the male parent?

Making New Connections

11. Sometimes breeders of plants and animals need to know if a plant or animal that has a dominant phenotype has a genotype that is homozygous dominant or heterozygous. One way to determine this is by doing a test cross. A test cross involves

- mating the individual of unknown genotype with an individual who is homozygous recessive for the trait
- analyzing the phenotypes of the offspring.

Explain how this helps breeders identify the unknown genotype. Use a Punnett square to work through possible crosses.

Natural & Artificial Selection

QP Questioning and Predicting PC Planning and Conducting PA Processing and Analyzing E Evaluating
AI Applying and Innovating C Communicating

Understanding Key Ideas

1. Explain how mutations are a source of new alleles. PA
2. In a population of sparrows, most birds have a beak that is about 10 mm long. Some birds, however, have beaks that are slightly longer or slightly shorter than the average. Explain why this variation within the population is important in terms of survival of individual sparrows. PA C
3. Why does genetic variation make it possible for changes in populations to occur through natural selection? Explain your answer. E C
4. How does natural selection influence adaptation? PA
5. Explain how the ability of a population of insects to withstand the effects of an insecticide is an example of natural selection. C
6. Severe flooding results in a river changing course. Explain how a species of mouse that now lives on both sides of the river might eventually become two different species. What about a species of bird that now lives on both sides of the river? Explain. QP C
7. The Greater Antilles is a group of islands in the Caribbean. These islands include Cuba, the Dominican Republic, Haiti, Jamaica, and Puerto Rico. Each island is home to many lizard species that look very similar. DNA analysis shows that the similar-looking lizards from different islands are not alike genetically. Explain this. E C
8. Use a graphic organizer of your choice to identify and describe different types of mutagens and examples of each. C
9. Give an example of how people have used selective breeding to create a new variety of plant. Describe two possible consequences of the new variety. PA C

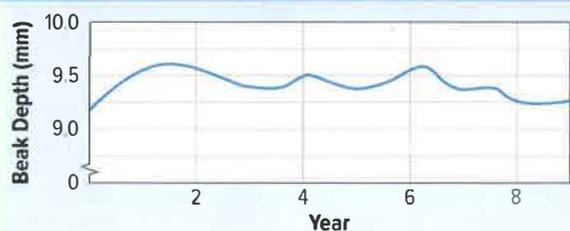
Connecting Ideas

10. Many antibacterial soaps and sprays are available without a prescription. Why might your doctor suggest that you avoid using (or restrict your use of) these products? AI

Making New Connections

11. The medium ground finches (*Geospiza fortis*) of the Galapagos Islands use their strong beaks to crush seeds. They prefer the small seeds that are abundant during wet years. During dry years, fewer small seeds are produced. Therefore, the finches also have to eat larger seeds, which are more difficult to crush. Researchers have measured the depth (dimension from top to bottom) of the finches' beaks, which relates to strength. The deeper the beak, the stronger it is. Use the graph to answer these questions. PA E
 - a) Years 1, 4, and 6 were drought years. Year 8 was wet. What do you notice about the average beak depth in the finch population during dry years compared with wet years?
 - b) How do the data relate to selective pressure and natural selection?

Changes in Beak Depth of *Geospiza fortis* over Eight Years



Genetic Modification

Understanding Key Ideas

1. Use a flowchart with diagrams to summarize gene cloning. 📄 📊
2. What is the benefit of producing insulin from transgenic plants rather than transgenic bacteria?
3. A company has developed a transgenic carrot that secretes toxins that kill damaging insects and worms. 🐛
 - a) What are some of the risks and benefits that you think the Canadian government should consider when deciding whether to approve this plant for agricultural use?
 - b) If approved, what advantages will this transgenic carrot offer to farmers? What are some of the potential drawbacks to farmers?
 - c) Do you think that foods produced with genetically modified ingredients should be labelled so that consumers can make informed choices? List your arguments.
4. Explain the steps involved in in vitro fertilization. 📄
5. Use a graphic organizer of your choice to help explain how gene therapy works.
6. Copy the following table into your notebook and complete it.

Applications of Biotechnology

Application	Benefits	Risks/ Concerns
Cloning		
Genetically modified organisms		
Gene therapy		

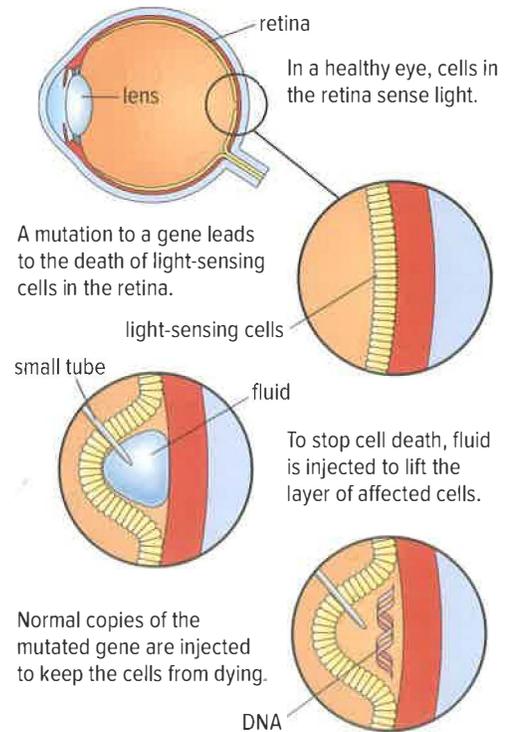
7. How can transgenic organisms help to achieve social, economic, or environmental goals? Give one example of a transgenic organism designed to meet one of these goals.

Connecting Ideas

8. Many people have life-threatening allergies to certain foods, such as nuts. Researchers are developing transgenic peanuts that will not produce allergic reactions. Do you think this is a good use of research money? Explain. 📄

Making New Connections

9. Study the diagram below. What does it show? Explain your reasoning. 📄 📊



Biology Review

What Do You Know?

Connecting to Concepts

Visualizing Ideas

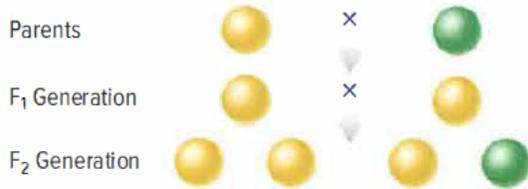
1. Study the photo here. How does DNA account for both the similarities and differences among the different varieties of apples?



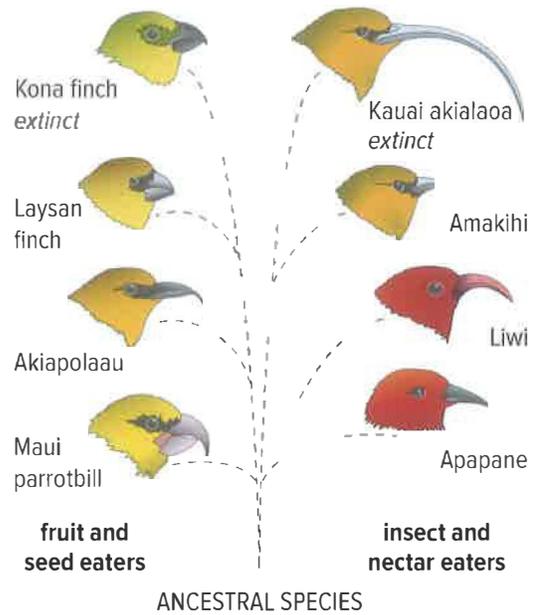
2. Suppose you have to explain the concept of homologous chromosomes to a Grade 6 class. How could you use the diagram on the right as part of your explanation? What labels would you add?



3. The diagram below shows the results of two crosses. Explain the results and the genetic principle that is illustrated.



4. The image at the top of the next column shows what happened over time to a group of birds called honeycreepers after an ancestral species reached the Hawaiian Islands. Each island has different biotic and abiotic conditions. Identify and describe the concepts shown.



Using Key Terms

5. Create a table with three columns. In the first column, list all the key terms from this unit. In the second column, record a definition for each term, written in your own words. In the third column, sketch or draw a small picture that can help you remember the term and its meaning.
6. In a format of your choice, show how the term *DNA* relates to following terms from this unit:
 - gene
 - species
 - population
 - traits
 - mutation
 - natural selection
 - adaptation
 - adaptive radiation
 - artificial selection
 - monoculture
 - biotechnology

Communicating Concepts

7. Scientists often describe the structure of DNA by comparing it to a ladder. Draw a DNA molecule and use the drawing to explain how DNA is similar to a ladder. Then explain the limitations of this comparison.

- 8.** DNA sequences in a genome are compared to letters strung together in a book. Develop another analogy for how DNA, chromosomes, genes, and nucleotides are related.
- 9.** Sketch a small section of DNA. Use the sketch to describe how DNA's complementary nature enables accurate replication.
- 10.** "The sex chromosomes in a human are a homologous pair." Do you agree or disagree with this statement? Explain why.
- 11.** Distinguish between the following pairs of terms using a definition and an example.
- homozygous and heterozygous
 - dominant and recessive
- 12.** Given the phenotype of an individual, can you determine its genotype? Explain.
- 13.** Since Mendel performed his experiments with pea plants, scientists have discovered that there are more complex patterns of inheritance. Use examples and diagrams to illustrate the differences among the following mechanisms:
- dominance
 - incomplete dominance
 - codominance
 - sex-linked inheritance
- 14.** In a Venn diagram, compare and contrast natural selection and artificial selection.
- 15.** Evolution is the process of biological change over time based on the relationships between species and their environments. Summarize how genetic variation is involved in biological change over time.
- 16.** Make a table to show three examples of transgenic organisms and describe their practical application.
- 17.** Make a flowchart to show the steps involved in gene cloning.
- 18.** There are many benefits to biotechnology, but there are also ethical concerns. Use a concept map to illustrate some of the benefits and concerns that are associated with the biotechnology topics discussed in this unit.

What Do You Know?

Connecting to Competencies

Developing Skills

- 19.** A female fruit fly that is homozygous dominant for red eyes is crossed with a white-eyed male fruit fly. Use a Punnett square to predict the genotype(s) and phenotype(s) of their offspring.
- 20.** Explain why there are varieties of houseflies that are not killed by a popular insecticide. Under what conditions is such resistance considered to be a selective advantage?
- 21.** Outline a breeding program that would help you develop a cow that produces more milk.
- 22.** Choose a species of animal, and describe two of its traits. Explain the adaptive value of both traits. Include a sketch with your explanation.
- 23.** Research a drug or other form of medical treatment that was developed using recombinant DNA technology. Describe what it is, its use, and any risks or controversies that are associated with its use.

Thinking Critically and Creatively

- 24.** Describe an experimental approach to determine which of two alleles for a gene is recessive.
- 25.** Develop a plot for a movie or play that involves the use of gene therapy. Ensure that your ideas are scientifically plausible.

Biology Review *(continued)*

26. In radishes, colour is controlled by two alleles, one for red colour and one for white colour. Inheritance of these alleles shows incomplete dominance. The photographs below show the phenotype for each possible colour: red, purple, and white. What phenotypic ratio would you expect from crossing two heterozygous radish plants?



27. State whether each of the following examples demonstrates artificial selection. Explain why or why not.
- A person breeds long-furred Persian cats.
 - A farmer increases the variability in the fat content of different plant species.
 - Over time, plants develop chemical defences that deter herbivores.
 - Crops are bred to be pest-resistant.

Understanding Big Ideas

Making New Connections

28. Imagine that you are a journalist writing an article for the magazine *Ethics in a Changing World*. You have been asked to research and explain the social and environmental implications of current genetics research. Suggested topics include gene cloning, transgenic crops to reduce hunger, in vitro fertilization, and gene therapy. Choose one topic and write an article on what you find.

Applying Your Understanding

29. A black-haired true-breeding guinea pig is crossed with a white-haired true-breeding guinea pig. All the offspring have black hair.
- Which hair colour is dominant?
 - What are the genotypes and phenotypes of the parents?
 - What are the genotypes and phenotypes of the offspring?
30. A yellow-haired rat is mated with a black-haired rat. Over time, the rats produce 45 black offspring and 52 yellow offspring. From these results, determine the *probable* genotypes of the parents and offspring. How could you determine the dominant allele?
31. Sickle cell anemia is an autosomal recessive disorder that results in the formation of abnormally shaped red blood cells. Write the genotypes for the following individuals:
- a person with sickle cell anemia
 - a person carrying the sickle cell allele
 - a homozygous person with a normal phenotype
32. Hemophilia is a disease that is due to an X-linked recessive allele. A man and woman who do not have hemophilia have a son who does have hemophilia. Explain how this can occur. If they have a daughter, could she have hemophilia? Explain.

Thinking Critically and Creatively

33. Sea stars eat clams by pulling apart the two halves of a clam's shell. Create a sequence of drawings to show how this could result in natural selection of muscle size in clams.
34. Adaptive radiation often occurs on islands. Would you expect to find more adaptive radiation on islands that are remote from the mainland, like small Pacific islands, or islands that are close to the mainland, like Vancouver Island? Explain your answer.

- 35.** Explain the following observations from a scientific research study that involved finches (*Geospiza fortis*) on the Galapagos Islands.
- During a drought in 1977, a large percentage of *Geospiza fortis* finches died of starvation on the Galapagos island Daphne Major.
 - The 90 bird survivors in 1978 had a beak depth from about 9.4 mm to about 10.2 mm, which was greater than the beak depth of the finches that did not survive.
- 36.** Scientists at the University of Guelph produced genetically modified pigs. These pigs were given the name Enviropig™ because they were genetically altered so that less phosphorus was excreted in their waste. High levels of phosphorus in animal waste can enter streams and lakes and act as a pollutant.
- a) What is one advantage of developing these pigs?
 - b) What is a potential risk of these pigs being produced?
 - c) These pigs were being considered as a source of food. Should genetically modified food that is to be consumed by people be labelled as such? Provide a supporting statement for your opinion.
- 38.** Indoor tanning beds work by exposing people to artificial ultraviolet light. Researcher have found that this increases a person's risk of developing a deadly form of skin cancer, called melanoma, by 20%.
- a) What do you know about the link between ultraviolet light and cancer?
 - b) Several countries have passed laws to restrict the use of tanning beds by teenagers. What are the regulations in British Columbia for the use of indoor tanning beds? Do you think these regulations are strict enough, too strict, or not strict enough? Why?
- 39.** Write a paragraph that summarizes how you think society has been affected by biotechnology and what the impact has been to date. In your paragraph be sure to include examples and information that support your opinion.
- 40.** Choose a crop plant that is grown in British Columbia that has been genetically modified to be more resistant to disease. Research the economic and environmental impacts that growing this crop has had in B.C. Give your opinion as to whether the crop should continue to be grown in B.C. or not. Use evidence from your research to support your opinion.

Connect to Self and Society

- 37.** In Canada, individual grizzly bears and populations of grizzly bears are being isolated as humans expand their use of land that was previously used by the bears.
- a) If the grizzly bear were to become extinct, what might some of the economic, political, and social implications be for Canada?
 - b) How might wildlife corridors help the situation? (Wildlife corridors are routes designed to help animals cross busy highways safely in mountain parks.)
- 41.** With modern technologies, scientists can retrieve DNA from 5000 year old bones found in archeological digs. Recently some First Nations people have shared their DNA with scientists to see if there are connections with the DNA of people who lived in the same area thousands of years before. The results of these studies often show direct links between contemporary First Nations and their ancestors. In what ways does this research help to bring together Indigenous scientific knowledge and Western science?