

McGraw-Hill Ryerson

BC Science CONNECTIONS



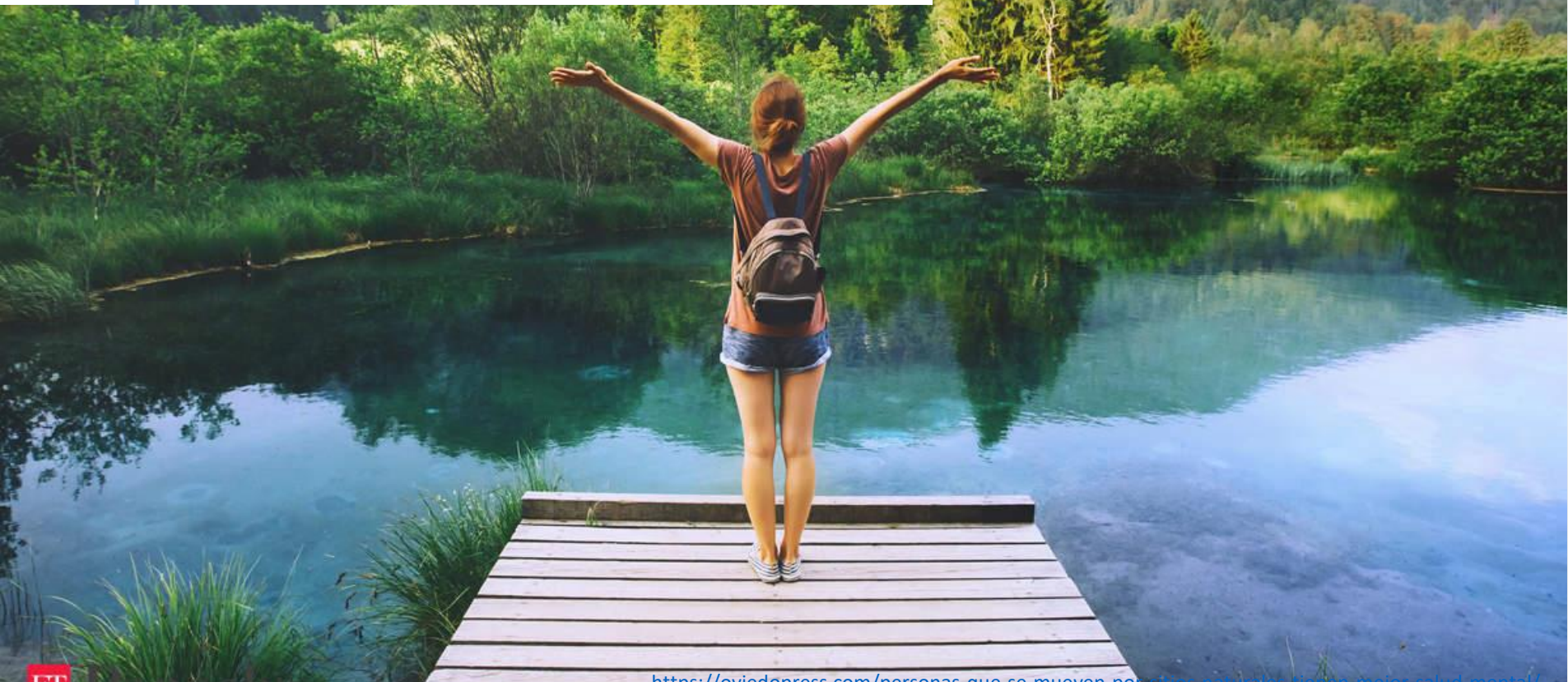
BC Science Connections 9

**Unit 1: The continuity of life depends on cells being
derived from cells**

Activity**Take a Nature Walk**

According to cell theory, all living things are made up of cells, which are derived from previously existing cells. Following your teacher's instructions, go for a nature walk. Record, digitally or in writing, all the organisms that you observe.

1. What does it mean to you that all the life you observe is made up of cells?
2. Record your thoughts, curiosities, and questions about cells and life around your school, your home, and other places that you are a part of.
3. Think about interconnectedness. How are the parts of a plant connected to what you observe? How is the sky connected? How are you connected?



Warm-up

Discuss the following questions in small groups.

1. What are some ways that all living things are similar? Different?
2. What is the purpose of reproduction?
3. What does sustainability mean to you? What are some human examples of sustainable behaviour? Non-sustainable? Challenge: What about in the natural (non-human) world?
4. What do you know about DNA? What about its role in reproduction?

Concept 1: Reproduction ensures that life exists beyond its present generation.

Kwantlen First Nation (Fort Langley): First Foods Ceremony

- Welcomes the return of salmon during the start of the salmon run
- Honours promise to renew and replenish the spirit and flesh



Figure 1.1

What is Reproduction?

Reproduction

- The process by which organisms make ‘copies’ of themselves
- Parents transfer genetic information (e.g. DNA) to offspring
- Ensures that life exists beyond its present generation



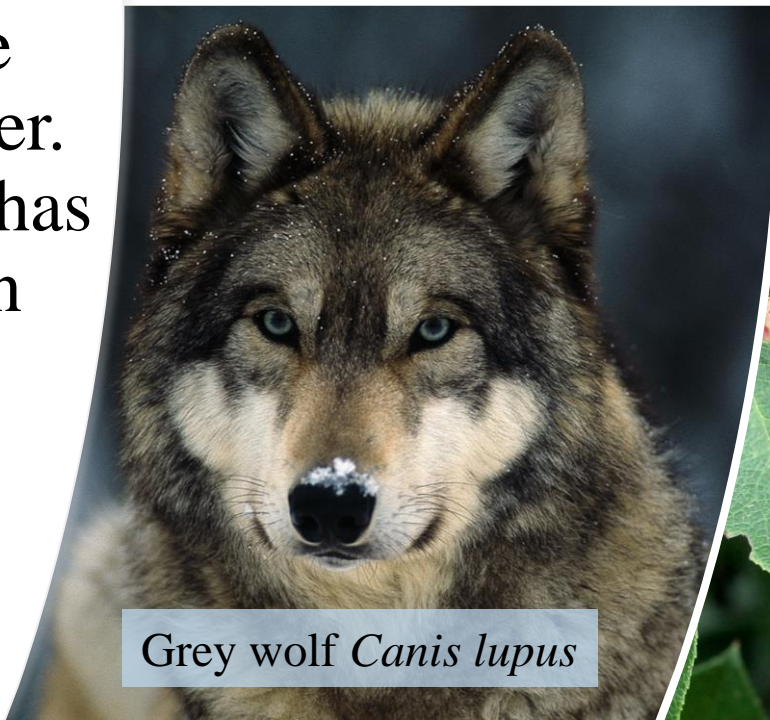
A **species** is a group of similar organisms that can reproduce with each other. Each species has a unique Latin name.



Killer whale: *Orcinus orca*



Douglas fir:
Pseudotsuga menziesii



Grey wolf *Canis lupus*



Salal: *Gaultheria shallon*

What is Continuity?

Continuity

- The ability of a species to persist over time (the opposite of extinction)
- Occurs when reproduction rate \geq death rate over time

Discuss: What factors affect the reproduction rate and death rate of a species?

The Continuity of Endangered Species is Threatened

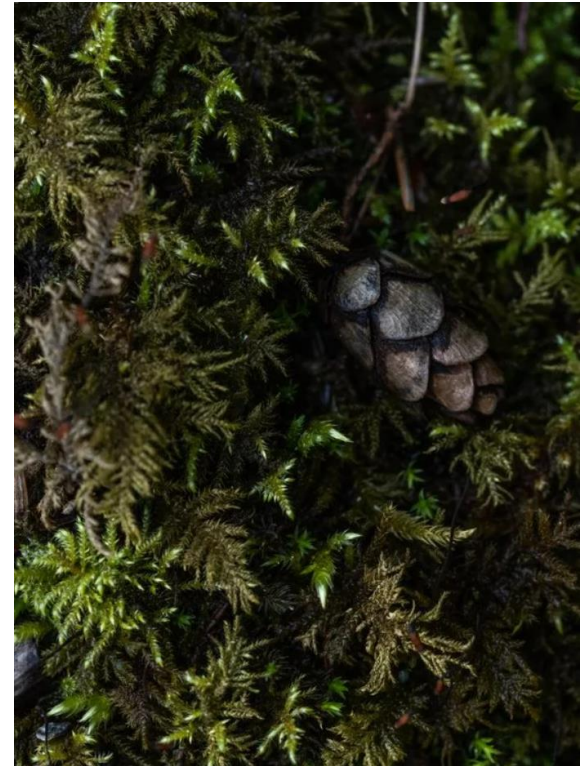
Note: all these species are threatened or endangered in BC as of 2022.



phantom orchid
Cephalanthera austiniiae



Oregon spotted frog
Rana pretiosa



poor pocket moss
Fissidens pauperculus

sockeye salmon
Oncorhynchus nerka



great blue heron
Ardea herodias

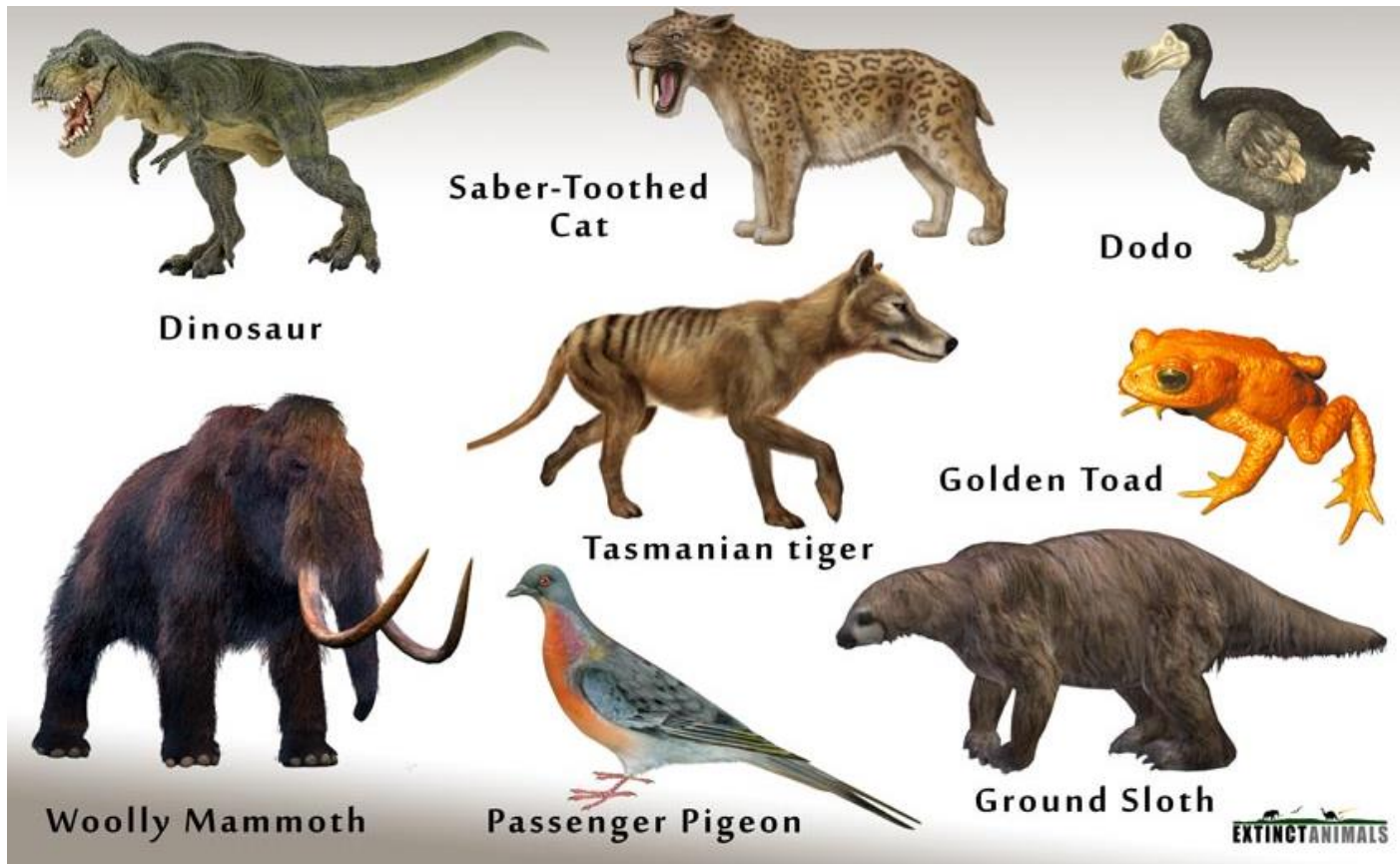
sea otter
Enhydra lutris



humpback whale
Megaptera novaeangliae

What is Extinction?

Without continuity (all the members of a species die without reproducing), that species becomes extinct.



What is Sustainability?

Sustainability:

- Ability of the environment and living things it supports to endure into the future

Discuss: What are factors (living and non-living) that are important for sustainability?



Figure 1.2: The Western Painted Turtle is found on B.C.'s southwest coast, where it is endangered.

Sustainability, Continuity, and Reproduction

Reproduction: production of offspring by *individuals*



Continuity: how each *species* of organism continues to exist over time



Sustainability: ability of the *environment and living things* it supports to endure into the future

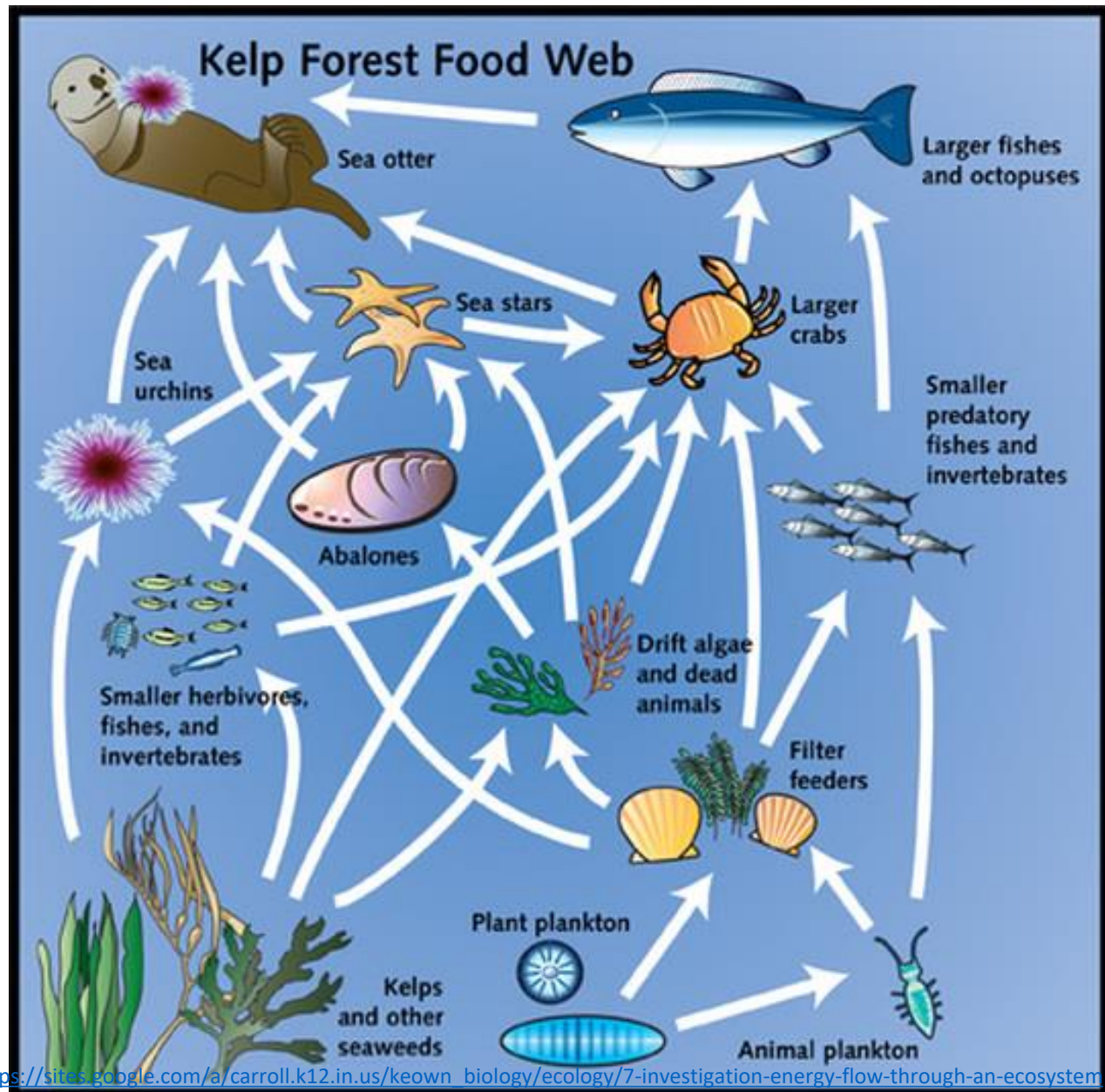


Sustainability, Continuity, and Reproduction

Reproduction affects sustainability:

- Reproduction ensures all organisms (in an ecosystem) have a source of nutrients and energy.
- Reproduction is required for continuity. Continuity is required for sustainability of ecosystems. (Therefore, reproduction is required for sustainability.)

Case Study: Kelp Forest



https://sites.google.com/a/carroll.k12.in.us/keown_biology/ecology/7-investigation-energy-flow-through-an-ecosystem

Case Study: Passenger Pigeon



<https://stillunfold.com/animal/top-6-ancient-animals-who-may-still-exist>
<https://theconversation.com/why-passenger-pigeons-went-extinct-a-century-ago-132736>

Discussion Questions

1. What does the word *continuity* mean in terms of reproduction?
2. How are these three terms related: *reproduction*, *sustainability*, *continuity*?

Cell Theory (Review):

- All living things are made of one or more cells
- All cells come from pre-existing cells
- The cell is the basic unit of life

Warm-up Questions

1. How many cells are in a fly? Hummingbird? Human?
2. What are the important components of cells that must be shared by the new cells?
3. How will the cells produced be the same or different from the initial cell?
4. How quickly do they think cells can divide? What happens to cells after they divide? Do they simply keep dividing, or is there a step between one cell division and the next?
5. Are there cells still dividing? Which ones? What roles do new cells play in their bodies?
6. What do they think would happen if someone's body could no longer make new cells? What would happen to their skin, or their hair, or their mouth, or blood cells?

Concept 2: Reproduction transfers genetic information from parents to offspring.

There are many different strategies for reproduction.

- A) Flowers: Colours and scents attract animals to transfer pollen
- B) Animals: Courtship rituals enable individuals to find mates
- C) Bacteria: Reproduce on their own by dividing in two

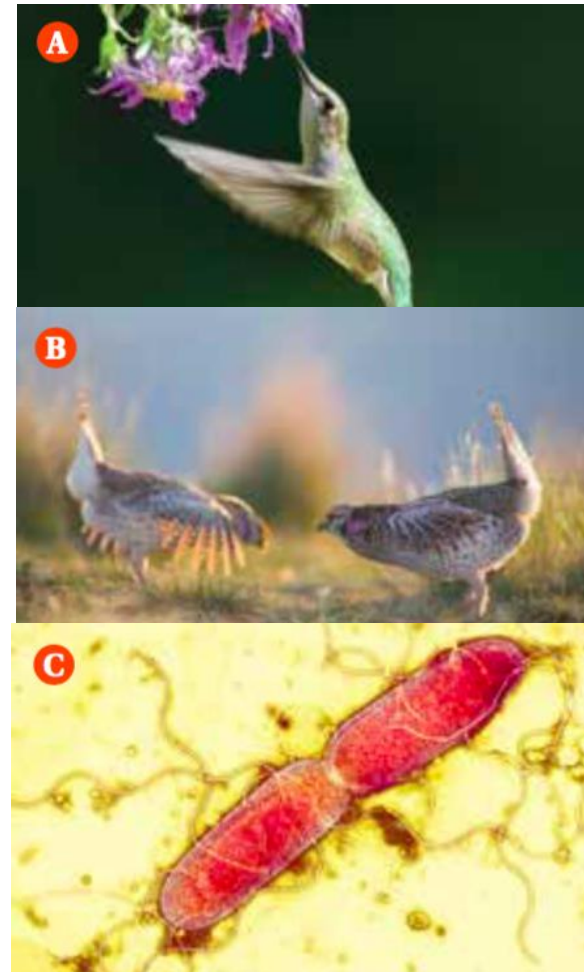


Figure 1.3: Examples of different strategies for reproduction

DNA and Reproduction

In reproduction:

- Genetic information is passed onto offspring
- Information is contained in DNA



Figure 1.5: DNA

What is DNA? How would you describe its structure?

DNA: An Organism's Genetic Material

DNA: Deoxyribonucleic acid

- Located in cell nucleus
- Stores the genetic information of an organism
- Make up genes, which determine how an organism looks, functions, and behaves

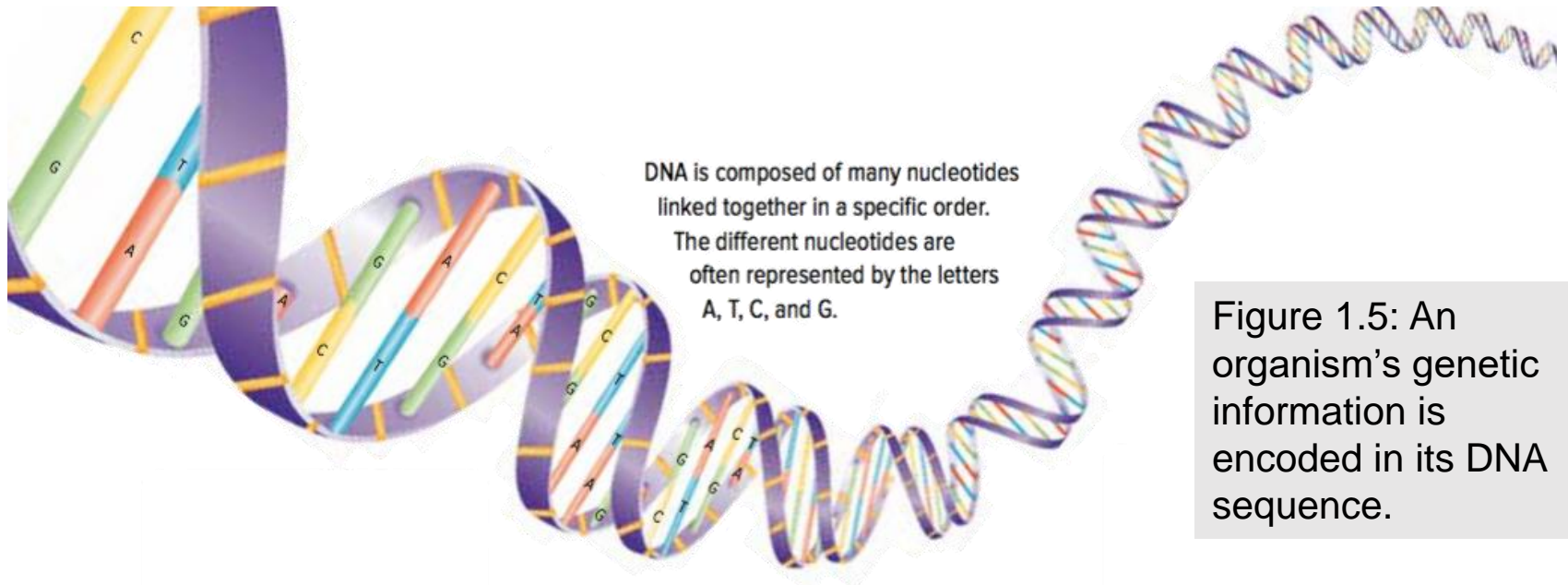
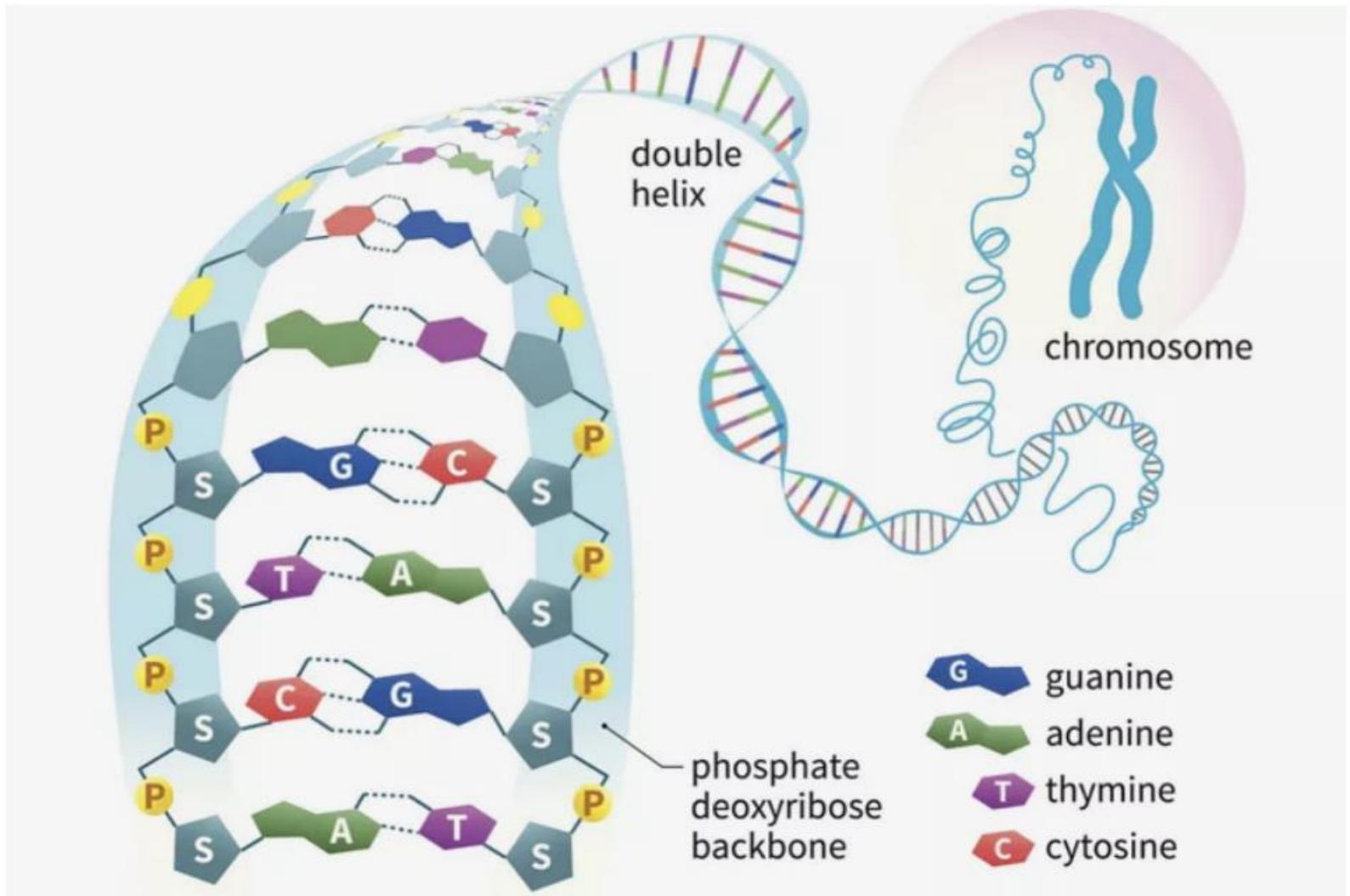


Figure 1.5: An organism's genetic information is encoded in its DNA sequence.

DNA: Structure and Function



jackom / DigitalVision Vectors / Getty Images

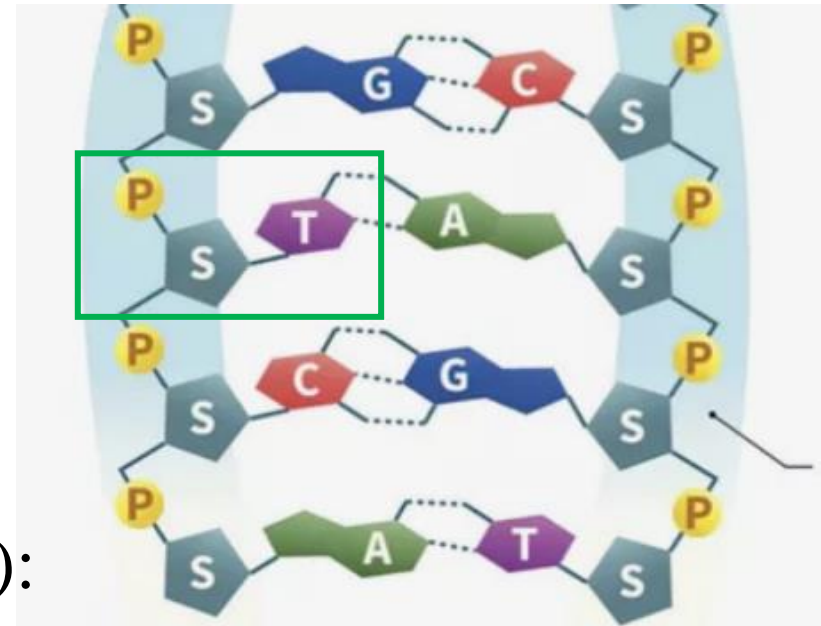
<https://www.thoughtco.com/nucleic-acids-373552>

DNA: Structure and Function

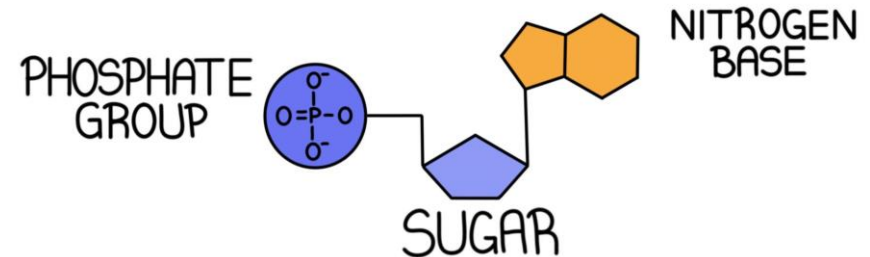
Nucleotides are the building blocks of DNA.

Each nucleotide contains:

- *Sugar*
- *Phosphate* group
- *Nitrogenous base* (4 types):
 - Adenine (A)
 - Thymine (T)
 - Cytosine (C)
 - Guanine (G)



NUCLEOTIDE

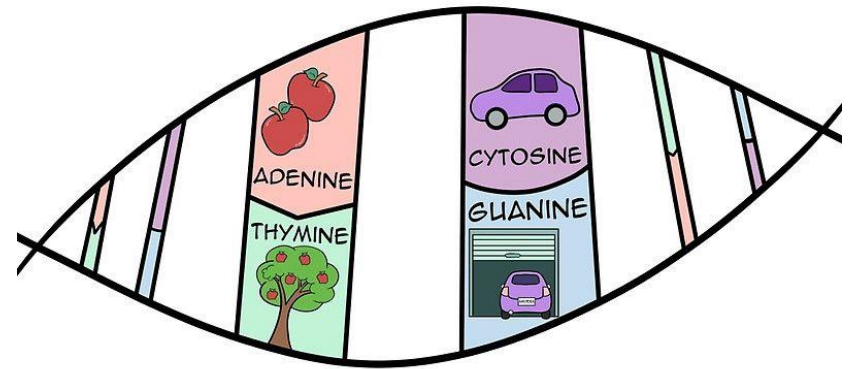


DNA: Structure and Function

- DNA is made of two long nucleotide strands shaped like a twisted ladder (“**double helix**”)
- Nitrogenous bases are always paired:
 - Adenine with Thymine
 - Cytosine with Guanine



"Apples in the Tree"



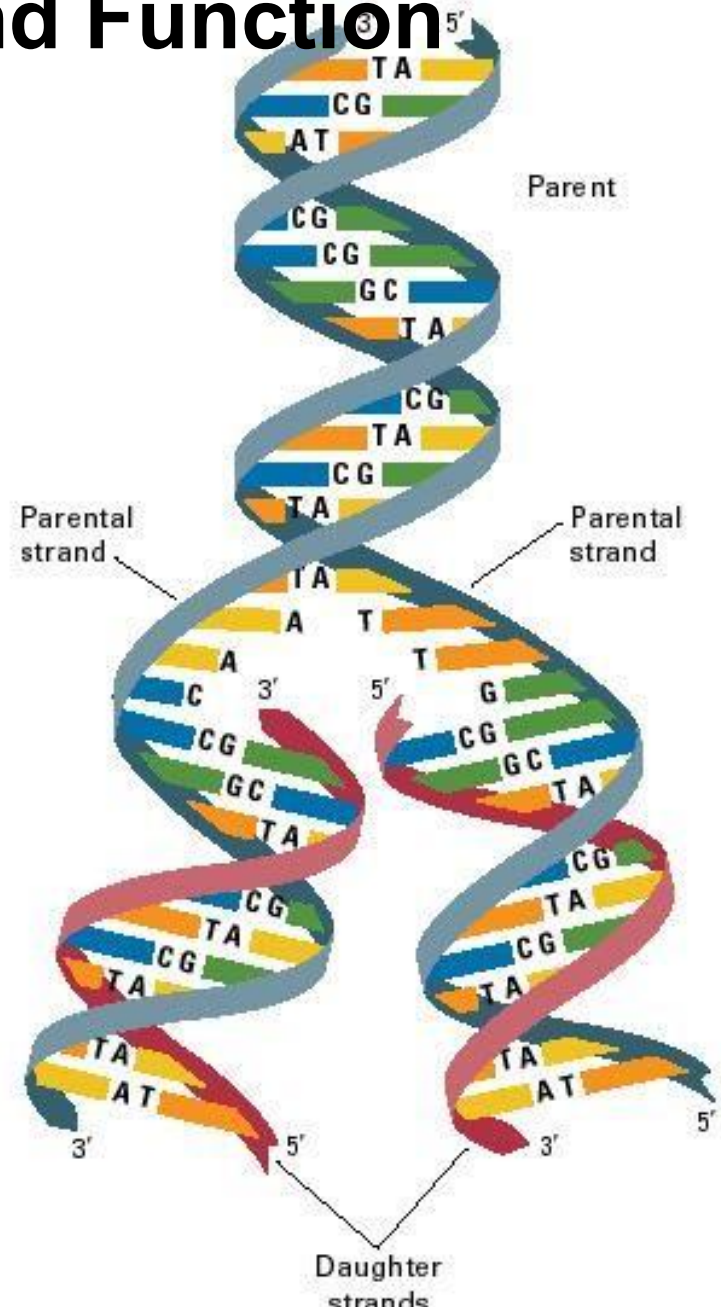
"Car in the Garage"

DNA: Structure and Function

Thought Experiment:

Why is DNA double-stranded?

- Stability of molecule
- Can make two copies from a single DNA molecule
(cell division: each cell needs its own DNA)



DNA Activity 1

1. Write the letters of your full name down on a scrap piece of paper.
2. Now, scramble the letters in your name. Is this still your name?
3. Just like in DNA, the order of letters in your name makes a difference! “David” is an entirely different person than “Vidda”...all because of the order!
4. The order of nucleotides in DNA is called the **DNA sequence**.

DNA: Structure and Function

DNA sequence:

- The specific order of nucleotides in an organism's DNA
- Is the “code” that holds the genetic information

DNA Activity 2

1. Roll a 4-sided die, ten times. Write down your results using the following code.

1 = A

2 = T

3 = C

4 = G

2. Your 10-letter code is one strand of your two-stranded DNA. Use complementary base pairing rules to determine the sequence of the other strand.
3. Use the materials provided by your teacher to create a 2-D DNA strand.

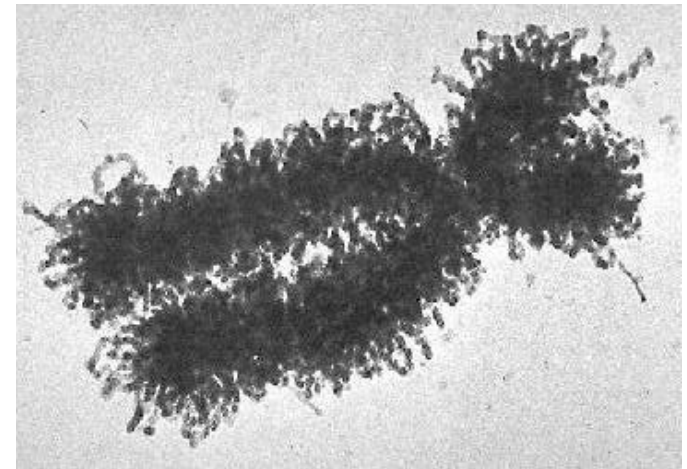
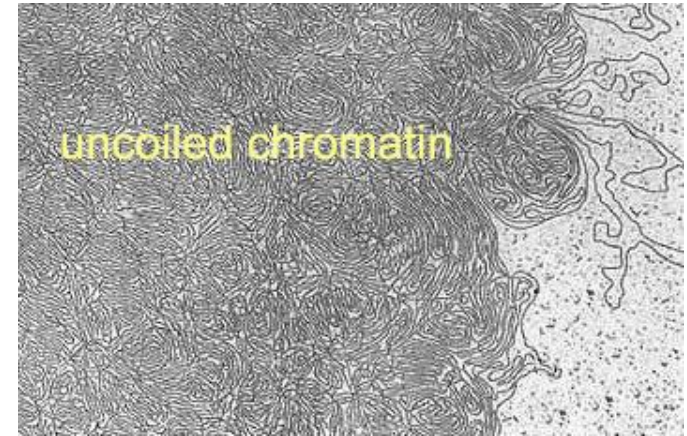
DNA: Structure and Function

One copy of DNA is stored in the nucleus of every cell.

- **Chromatin**: semi-compact, “noodle-like” form of DNA

A complete set of DNA needs to be passed on to new cells:

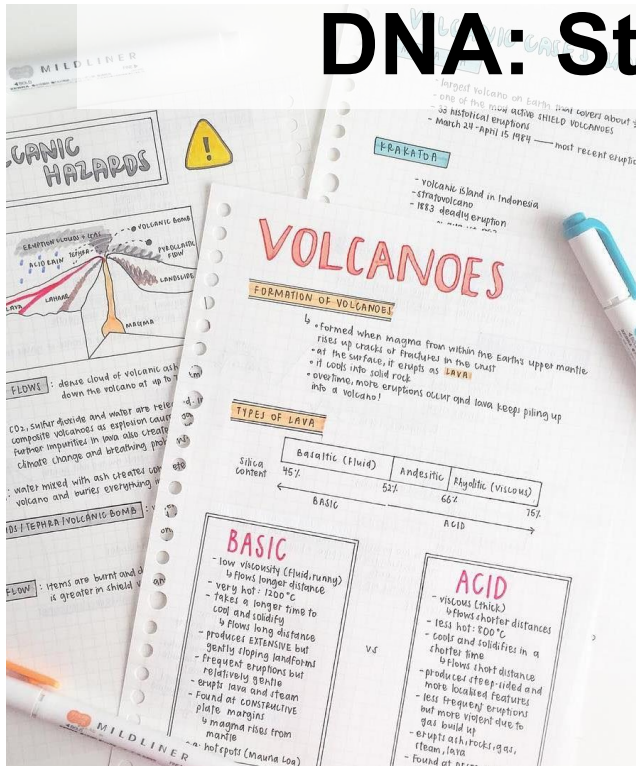
- DNA condenses further into structures called **chromosomes** when the cell is ready to divide



<https://newscenter.lbl.gov/2002/11/15/unraveling-the-secrets-of-gene-regulation/>

<https://www.sciencelearn.org.nz/images/1632-electron-micrograph-of-a-human-chromosome>

DNA: Structure and Function



Nucleotides are like the words on pieces of paper. To 'study', you can only look at one page at a time. Cells uncoil DNA fully when they use nucleotide sequences to code proteins.

Chromatin is like organized stacks of paper. When needed, specific pieces of DNA can be accessed.

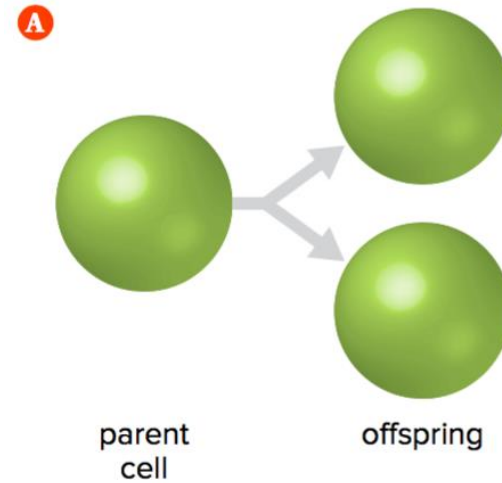
Chromosomes are like moving boxes filled with paper. You are much less likely to 'leave DNA behind' when packaged this way.

<https://www.pinterest.fr/pin/348466089910768586/>
<https://sossimpleorganizedsolutions.com/a-strategy-for-paper-piles/>
<https://blog.padmapper.com/2010/07/22/how-to-find-free-moving-boxes/>

Two Basic Types of Reproduction: Asexual and Sexual Reproduction

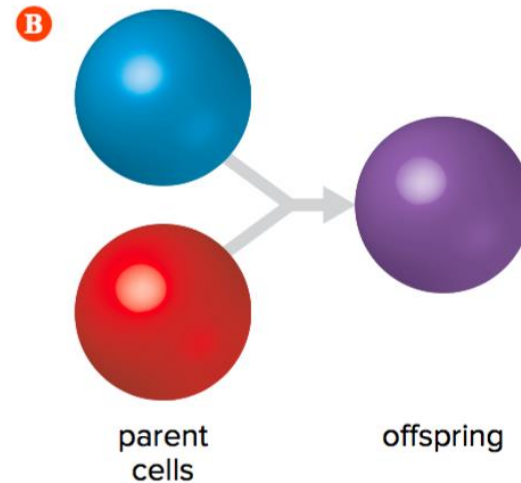
Asexual reproduction:

- Requires only one parent
- Produces genetically identical offspring



Sexual reproduction:

- Requires two parents
- Produces genetically different offspring

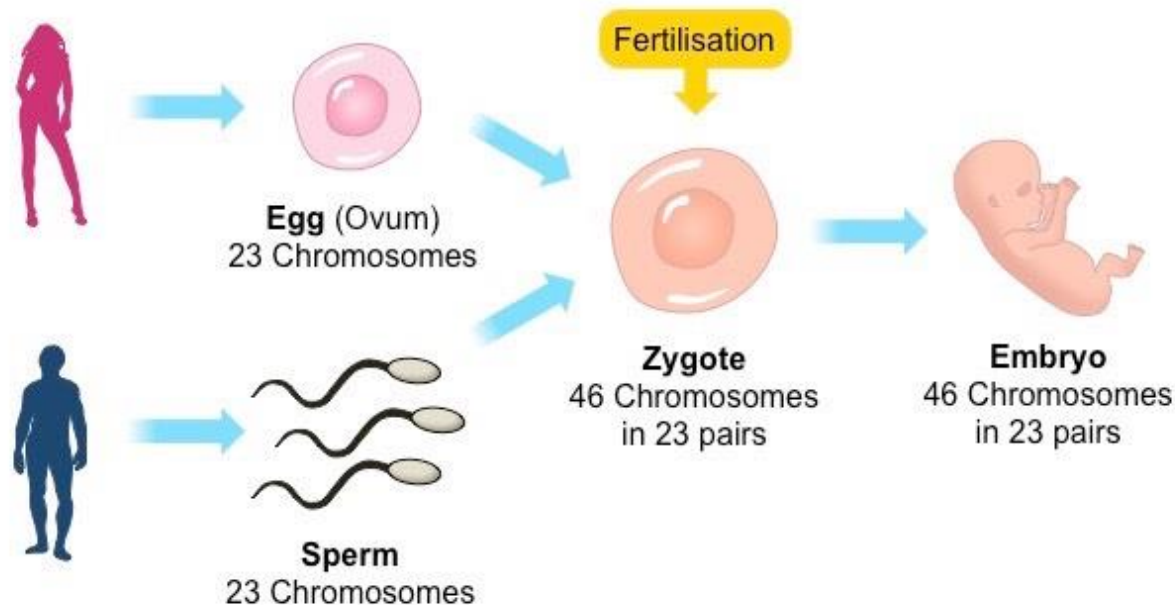


Reproduction and Chromosomes

Reproduction must provide offspring with the same amount of DNA as the parent(s).

Asexual reproduction: all chromosomes are passed down to offspring

Sexual reproduction: half of chromosomes are passed down from each parent



Discussion Questions

1. What is the function of DNA?
2. How is sexual reproduction different from asexual reproduction?
3. Compare and contrast chromatin and chromosomes. When is DNA stored as each?

DNA Activity

Use the reference images (and the internet) to complete the following.

1. Draw the chemical structure of each of the nucleotides (A, C, G, T) (copy from Figure 1). Then, for each nucleotide:
 - a) Clearly identify each of the three components: nitrogenous base, phosphate group, 5-carbon sugar.
 - b) Label where it would connect to nucleotides that come before and after it in the same strand.
 - c) Label (in a different way than #2) where it would connect to its complementary base pair.
2. Use the premade nucleotides to make a (double-stranded) string of DNA that is 10 nucleotides long.

Topic 1.1 Summary: Why is the reproduction of cells important?

- Reproduction ensures that life exists beyond its present generation
- Reproduction transfers genetic information from parents to offspring

