VOCABULARY (1.1)

IMPORTANT TOOL: MICROSCOPE

- focuses light or beams of electrons through a lens to produce a larger image
magnification: condition of things appearing larger than they are

resolution: shows clear details of an object to separate it from another structure next to it
What are **cells**?

- form parts of an organism/living things
- carry out its functions
- basic units of structure and function in living things
What are **functions**?

- processes that allow an organism to live, grow and reproduce (make more)
- Examples: getting oxygen, food and water; getting rid of waste
VOCABULARY (1.1)

CELL THEORY

- All living things are composed of **cells** (the basic units of structure and function in living things)
- All cells are produced from other cells
- Cells can provide **clues** about functions that living things perform
- Scientists can study cells to learn about growth and production
CELL THEORY

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- Scientists can study cells to learn about growth and production
Each kind of cell structure has a different function/job within the cell

- **cell wall**: a rigid/strong/stiff layer that surrounds the cells of plants and other organisms (animal cells do not have cell walls)
- **cell membrane**: controls which substances pass in and out of a cell
- **nucleus**: large oval structure controls the cell, directs all of the cell’s activities
VOCABULARY (1.2)

- organelles: tiny cell structures that have specific functions in a cell
- The nucleus is the largest of these.
VOCABULARY (1.2)

- **ribosomes**: found in the nucleolus (in the nucleus); produce proteins
- **cytoplasm** – fills the space between cell membrane & nucleus; fluid moves constantly & carries other parts
VOCABULARY (1.2)

- **mitochondria**: convert energy stored in food to energy the cell can use to live
- **endoplasmic reticulum (ER)**: an organelle with membranes that connect to produce many substances
**VOCABULARY (1.2)**

- **Golgi apparatus:** receives proteins and other new material from the ER, packages them and distributes them to other parts of the cell or out of it.
VOCABULARY (1.2)

- **vacuole:** stores water, food, or other materials needed by the cell
- **lysosomes:** organelle sacs that contain substances that recycles cell parts in animal cells
chloroplast: green structures in a plant cell’s cytoplasm; captures energy from the sun and changes it into energy the plant uses to make food (why leaves are green)
**VOCABULARY (1.2)**

**unicellular**

(uni = one)

single-cell organism

**multicellular**

(multi = many)

made of many cells

**SPECIALIZED CELLS**

have specific functions to help the whole organism
**tissue:**
A group of similar cells that work together for a specific function.

**organ:**
Different tissues that work together. An **organ system** is a group of organs that work together for one major function.
VOCABULARY (1.3)

REVIEW:

- **Elements** are the simplest substances, and can’t be broken down; they have specific physical and chemical properties.
- **Compounds** are substances made of 2 or more elements represented by a chemical formula.

![Periodic Table of the Elements]

![Caffeine Molecule]
WE ARE WHAT WE EAT
CARBOHYDRATES

- energy-rich organic compounds made of carbon, hydrogen & oxygen
- the body breaks down the starch into glucose (sugar cells use to get energy)
- found in cell walls and membranes
VOCABULARY (1.3)

WE ARE WHAT WE EAT

- compounds made mostly of carbon & hydrogen, and some oxygen
- found in the cell membrane
- cells store this energy for later use

LIPIDS
WE ARE WHAT WE EAT

- large organic molecules made of carbon, hydrogen, oxygen, nitrogen & sometimes sulfur
- forms part of the cell membrane and organelles in a cell
- enzymes (a group of proteins) speed up chemical reactions in organisms
Why is the cell membrane important?

- made up of two layers of lipids
  - some proteins are within the layers of lipids
  - chains of carbohydrates are attached
    > other carbohydrate chains sit on the surface

- the cell membrane is selectively permeable
  - some substances can pass through freely while others cannot
Substances that move in and out of the cell can do it in one of 2 processes:

- **PASSIVE TRANSPORT**
  - movement of dissolved materials across the cell membrane without using the cell’s energy

- **ACTIVE TRANSPORT**
  - movement of materials across the cell membrane using the cell’s energy
VOCABULARY (1.4)

PASSIVE TRANSPORT

- **diffusion** – process where molecules move from an area of higher concentration to lower concentration
  
  (concentration = deep strength; absorption)
PASSIVE TRANSPORT

- **osmosis** – diffusion/scattering of water molecules across a selectively permeable membrane
PASSIVE TRANSPORT

- facilitated diffusion – proteins in the cell membrane make channels/passages where sugars can pass/flow through easily
ACTIVE TRANSPORT

- **endocytosis** – process where the cell membrane changes shape and surrounds a particle
ACTIVE TRANSPORT

- **exocytosis** – process that allows large particles to leave the cell
VOCABULARY (2.1 AND 2.2)

ENERGY FROM THE SUN

- energy used by living things comes from their environment
  (example: grass is the energy for cows)
- plants and other organisms obtain/get energy from sunlight to make their own food

Nearly all living things obtain energy directly or indirectly from the energy of sunlight
ENERGY FROM THE SUN

- **autotroph** (producers)
  an organism that can *make* its own food

- **heterotroph** (consumers)
  an organism that cannot make its own food; obtain/get their food by *consuming/eating* other organisms
PHOTOSYNTHESIS

- (light + putting together)
- process where a cell captures energy in sunlight & uses it to make food

<table>
<thead>
<tr>
<th>Ingredients</th>
<th>Product</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sunlight</strong> +</td>
<td>“CH₂O” + O₂</td>
</tr>
<tr>
<td>H₂O + CO₂ + Nutrients</td>
<td></td>
</tr>
<tr>
<td>Water</td>
<td>“Organic matter”</td>
</tr>
<tr>
<td>Carbon dioxide</td>
<td>Oxygen</td>
</tr>
<tr>
<td>Nitrate NO₃</td>
<td>Creates glucose</td>
</tr>
<tr>
<td>Phosphate PO₄</td>
<td></td>
</tr>
<tr>
<td>Iron</td>
<td></td>
</tr>
<tr>
<td>Silica</td>
<td></td>
</tr>
<tr>
<td>among others</td>
<td></td>
</tr>
</tbody>
</table>
PHOTOSYNTHESIS

- **chlorophyll** - captures light energy and converts it to a form used in the second part of photosynthesis (making food)
  - found in chloroplasts
  - provides color
VOCABULARY (2.1 AND 2.2)

Sunlight strikes chlorophyll molecules in leaves and is captured.

Water and carbon dioxide are taken from the environment. Glucose is formed and oxygen is released.
CELLULAR RESPIRATION

- process where cells get energy from glucose, then release energy by breaking down glucose and other molecules with oxygen.
CELLULAR RESPIRATION

- Cells of living things (organisms) carry out cellular respiration continuously (all the time)
  - When cells need energy they take it from glucose
  - Breathing removes waste products from your body
CELLULAR RESPIRATION

- It is a two-stage process

1. - occurs in the cytoplasm of the cell
   - molecules of glucose are broken down
   - oxygen is not involved
   - only a small amount of energy is released
CELLULAR RESPIRATION

- It is a two-stage process

2.) - takes place in the mitochondria
   - small molecules are broken down more
   - requires oxygen
   - releases a lot of energy
FERMENTATION

- cells release energy from food, not oxygen
- process used by organisms that don’t have enough oxygen to carry out cellular respiration (it releases a lot less energy than cellular respiration)
CELL DIVISION

- allows organisms to grow, repair damaged structures and reproduce
- **single-cell organisms**: reproduce/make more of their kind when one cell divides itself
- **multi-cell organisms**: can reproduce when special cells from two “parents” combine to make a new cell
  - this new cell keeps dividing and a new organism/living thing is formed
VOCABULARY (2.3)

CELL CYCLE

- when a cell grows, prepares to be divided, and then divides into 2 new “daughter” cells
  - each “daughter” then begins the cell cycle again

There are THREE (3) STAGES....
**STAGE 1: INTERPHASE**

- **growing**: the cell grows to its full size; it produces organelles, ribosomes, mitochondria and enzymes it needs

- **replication**: the cell makes a copy of its DNA; DNA and proteins form **chromosomes** (threadlike structures)

  - At the end of replication, the cell contains TWO (2) identical sets of chromosomes
STAGE 1: INTERPHASE

- **division**: the cell produces/makes structures that will help divide into two new cells
  - in animal cells only, a pair (2) of centrioles is duplicated (for a total of 4 2x2)

At the end of Stage 1 (Interphase), the cell is ready to divide.
STAGE 2: MITOSIS

- the cell’s nucleus divides into two (2) new nuclei
- one set of DNA is given to each daughter cell

There are FOUR (4) PHASES....
**VOCABULARY (2.3)**

**STAGE 2: MITOSIS**

- **prophase**: chromosomes condense/become smaller and turn into shapes that you can see under a microscope

- One copy of each chromatid will move into the daughter cell in the last phase of mitosis

- When the chromatids separate, they are chromosomes again

- Each cell then has a complete copy of DNA.
**STAGE 2: MITOSIS**

- **metaphase**: each chromosome attaches/sticks to a *spindle* fiber at its centromere.

- **anaphase**: the centromere of each chromosome splits, pulling chromatids apart; each chromatid is now a chromosome; the cell stretches out.

- **telophase**: nuclei are formed; the spindle fibers disappear; the cell is tied together in the middle.
VOCABULARY (2.3)

STAGE 3: CYTOKINESIS

- completes the process of cell division
- cytoplasm divides, and is given to two new cells
- starts at about the same time as the telophase
- when complete, each daughter cell has the same number of chromosomes as the parent cell
- at the end of cytokinesis, each cell begins the cell cycle process again
STAGE 3: CYTOKINESIS

- **animal cells**: the cell membrane squeezes together around the middle of the cell; the cytoplasm gets tied into two cells; each daughter cell gets about half of the organelles from its parent cell.

- **plant cells**: a *cell plate* forms across the middle of the cell, and begins to form new cell membranes between the two daughter cells; new cell walls form.
GREGOR MENDEL
The Father of Genetics
(1822-1884)

- priest who performed experiments in his garden
- his study of why plants grew differently than others led him to discover genetics
- his discovery of genes and alleles changed scientists’ ideas about heredity
WHAT IS HEREDITY?

- passing of physical traits from parents to offspring (children)
  - **trait**: specific characteristics
  - **genetics**: the scientific study of heredity
WHAT IS HEREDITY?

- **gene**: factors that control a trait

- **alleles**: different forms of a gene
WHAT IS HEREDITY?

- alleles: different forms of a gene
  - DOMINANT always shows up
  - RECESSIVE stays hidden when the dominant allele is present
<table>
<thead>
<tr>
<th>Dominant Gene</th>
<th>Recessive Gene</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cleft Chin</td>
<td>No Cleft</td>
</tr>
<tr>
<td>Widow’s Peak</td>
<td>No Widow’s Peak</td>
</tr>
<tr>
<td>Dimples</td>
<td>No Dimples</td>
</tr>
<tr>
<td>Brown/Black Hair</td>
<td>Blonde Hair</td>
</tr>
<tr>
<td>Freckles</td>
<td>No Freckles</td>
</tr>
<tr>
<td>Brown Eyes</td>
<td>Gray/Blue Eyes</td>
</tr>
<tr>
<td>Free Earlobe</td>
<td>Attached Earlobe</td>
</tr>
</tbody>
</table>
WHAT IS HEREDITY?

- **fertilization**: process when egg and sperm cells join together to form a new organism
- **purebred**: the offspring of many generations that have the same form of a trait
WHAT IS HEREDITY?

- **hybrid**: has 2 different alleles for a trait

Genetic studies have shown that wolves in the eastern U.S. and Canada are actually hybrids of gray wolves and coyotes.
VOCABULARY (3.2)

PROBABILITY (Yes! Just like Math!)

- a number that describes how likely it is that an event will happen/occur
- laws of probability predict what is likely to
STOP!!! Let’s roll the dice!

How many sides/numbers are on a die?

What are the chances I will roll a 3?

Roll your die 10 times – how many times did you get a 3? (keep track in your notebook)
VOCABULARY (3.2)

How is PROBABILITY related to GENETICS?

- skills of probability can help predict how genetics will work (how do genes *cross*?)

- **Punnet Square**: a chart that shows all the possible ways alleles can combine in a genetic cross
VOCABULARY (3.2)

- **phenotype** [OUTSIDE] physical appearance (visible traits) of an organism

- **genotype** [INSIDE] an organism’s genetic make up (alleles)
2 other ideas describe an organism’s *genotype*:

- **homozygous**: when an organism has 2 **identical/same** alleles for a trait
- **heterozygous**: when an organism has 2 **different** alleles for a trait
**Vocabulary (3.2)**

Red is dominant; RR is the homozygous organism

White is recessive; rr is the homozygous organism

Rr are the heterozygous organisms made up of R (red) and r (white)
How do genetics and the environment work together?

- **inherited traits**: physical traits an organism is born with (like vocal chords and tongues)

- **acquired traits**: skills organisms learn to do, or physical traits that are developed (like speaking another language, or getting a blister from too much walking)
VOCABULARY (3.2)

How do genetics and the environment work together?

- Environmental factors/issues can affect the way genes turn out
  - Example: do you have a chance/opportunity to take music in school? Then you can develop a “musical gene”.
  - Example: smoking can create lung cancer
  - Example: plants are native to some parts of the world but not others because of the weather
**VOCABULARY (3.4)**

**CHROMOSOME PAIRS**

- fertilized eggs that form when a sperm cell and egg cell meet has 24 chromosomes
  - this is the same number that the parent has
  - the chromosomes are together in pairs (12)
  - one chromosome comes from the father; one chromosome comes from the mother
Remember: alleles are different forms of a gene (example: eye color is the gene we carry; blue, brown or green is the allele)

alleles come in pairs, just like chromosomes

genes pass from parents to their offspring on chromosomes
the body cells of humans contain 46 chromosomes (23 pairs)

chromosomes are made up of genes joined together, like beads on a string

body cells each contain 20,000-25,000 genes
VOCABULARY (3.4)

GENES and CHROMOSOMES

- A cell
- Chromosome - 23 pairs
- The chromosome is made up of genes
- The genes consist of DNA
MEIOSIS

- process of cell division where the number of chromosomes is reduced [made less] by half
  - chromosome pairs separate into 2 different cells, then divide again (total of four cells)
  - chromosomes duplicate (make a copy) before the first cell division
VOCABULARY (3.4)

MEIOSIS

- sex cells form during this process
  - only have half as many chromosomes as other cells in the organism
  - when 2 sex cells join during fertilization, the new cell has the full number of chromosomes
MEIOSIS

parent cell

chromosomes make identical copies of themselves

similar chromosomes pair up

sections of DNA get swapped

pairs of chromosomes divide

chromosomes divide

More to come…
VOCABULARY (4.3 and 5.3)

MUTATIONS

- any change in DNA of a gene or chromosome

The violet eyes of actress Elizabeth Taylor were a genetic mutation of dominant Brown alleles and recessive blue alleles.

Red hair is a genetic mutation of dominant Brown alleles and recessive blonde alleles.
VOCABULARY (4.3 and 5.3)

MUTATIONS

- any change in DNA of a gene or chromosome

There are physical mutations that can happen, causing physical **deformities** and **illnesses**.
VOCABULARY (4.3 and 5.3)

MUTATIONS

- **size:** it could be a small block of DNA or a large part of a chromosome

- **it can happen 2 ways:** inherited from a parent, or developed during a person’s life
  - Mutations can either be something that changed in a cell, or environmental factors that affect you (e.g. rays from the sun, which can cause cancer)
OTHER CHANGES

- **selective breeding**: process of selecting organisms with specific traits to be parents of the next generation.

- **inbreeding**: a technique that crosses 2 individuals that have similar characteristics.

- **hybridization**: when 2 genetically different individuals are crossed; the result is to have the best traits of both parents.
OTHER CHANGES

- **clone**: an organism that has exactly the same genes as the organism it was produced from.
- **genetic engineering**: process when genes from one organism are transferred into the DNA of another organism.
What is **NATURAL SELECTION?**

*“survival of the fittest”*

- process when individuals that have adapted well to their environment (are able to live well) are more likely to survive and reproduce than other members of the same species.
VOCABULARY (4.3 and 5.3)

Causes of natural selection:

- **overproduction**: in some species so many offspring are born that there are sometimes not enough resources (e.g. food, water)

- **variation**: any difference between individuals of the same species (e.g. “weak” runners)

- **competition**: can be *direct* (e.g. fighting) or *indirect* (e.g. not enough food to eat)
Causes of natural selection:

- **selection**: certain characteristics/traits get stronger with each generation, while weak traits begin to disappear.

- **environmental change**: genetic variations allow new traits to develop (e.g. flowers that can now grow in places they couldn’t before).
Causes of natural selection:

-gene changes: variations can happen when genes are changed or have different forms at the time that the egg cell and sperm cell meet

- only inherited traits (passed from parent to offspring) can be acted on by natural selection (e.g. height can create mutated genes that affect survival)