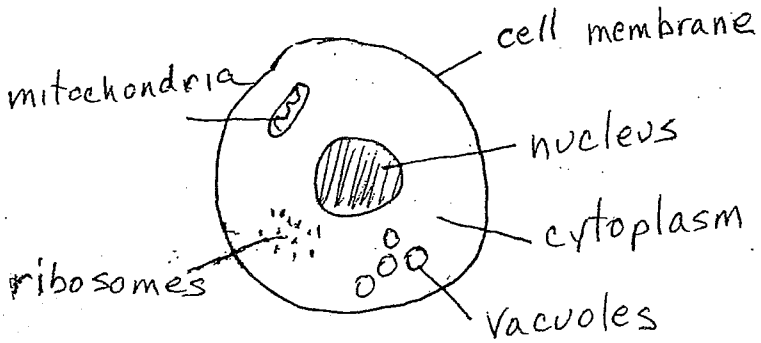
**Key Ideas for the Living Environment Regents**

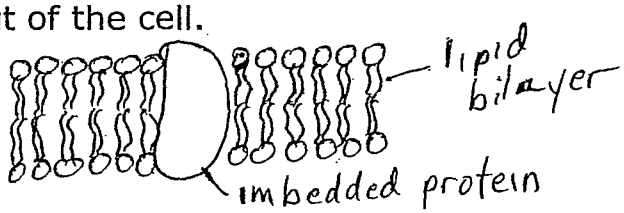
**Topic 1: Characteristics of Life**

1. **Cells**-all living things are made of cells
2. Every living thing carries out biochemical processes. All of these processes make up the organism's **metabolism**.
   - **synthesis** – building up from simpler parts.
   - **respiration** – breaking down nutrients to release energy from them. The energy from glucose is transferred to a usable form called **ATP**.
   - **nutrition** – acquiring nutrients through photosynthesis or consuming others.
   - **transport** – moving materials around a cell or around an organism
   - **excretion** – removing wastes
   - **growth** – increase in size
   - **reproduction** – producing more of the species
   - **control, coordination and response** – an organism responds to its environment to maintain **homeostasis**
3. **Homeostasis** – maintaining a stable internal environment.
4. Living things can pass on hereditary information when they reproduce (reproduction is not necessary for an individual's survival)
5. Made of organic (has carbon and hydrogen) and inorganic (does not have both carbon and hydrogen) materials.
6. Organelles→cells→tissues→organs→organ systems→organism
7. Cell structure –




- **cytoplasm** – site of many chemical reactions
- **nucleus** – contains DNA. DNA has the code (instructions) for making all the proteins the cell needs.
- **vacuoles** – store materials
- **mitochondria** – have enzymes for respiration; release energy (ATP)
- **ribosomes** – sites of protein synthesis
- **chloroplasts** – in plants only; contains chlorophyll, site of photosynthesis

**Cell membrane –** regulates what goes in and out of the cell.




- made of **lipids** with imbedded **proteins**
- **diffusion** – movement of molecules from high concentration to low concentration – **no energy** is used to enter or exit the cell
- **osmosis** – diffusion of water across a membrane

***Cells in salt water** will tend to shrink because water will leave the cell due to osmosis

***Cells in distilled water** will swell and burst (if animal cells) because water will enter the cell due to osmosis. Plant cells will not burst due to the rigid cell wall but turgor pressure will result due to the cell membrane pushing up against the cell wall.

- **Active transport** – goes against the concentration gradient; **must use energy**

8. Biochemistry –
   - **Carbohydrates** (like starch) are digested into simple sugars (like glucose) which are the building blocks of carbohydrates.
   - **Proteins** – are built of amino acids
   - **Lipids** – are built of glycerol and fatty acids

**Receptor molecules** – proteins in the cell membrane that are capable of receiving chemical messengers (like hormones or neurotransmitters) from other cells

**9. Human systems**

- **Digestive** – breaks down food into soluble forms which can be absorbed and transported to body tissues. Undigested food is eliminated as solid waste.
- **Respiration** – uses oxygen to break food down and release energy. The respiratory system exchanges gases between the blood and the environment
- **Circulation** – moves materials (like nutrients, oxygen, hormones, waste) to where they must go. Heart, blood vessels, blood. Pulse is a measure of the number of heartbeats in a minute.
- **Excretion** – getting rid of metabolic waste; kidneys, sweat glands in skin, lung, liver
- **Movement** – moving to avoid danger, find food, mates; skeleton and muscles
- **Coordination** – controls life processes; nervous (neurons, neurotransmitters), endocrine (glands, hormones)
- **Immunity** – ability to resist disease; white blood cells engulf invaders, make antibodies.

Comparing humans and other organisms

- Both are made of mainly C, H, O, N
- made of cells
- reproduce in similar ways
- DNA is our genetic material

**Topic 2: Homeostasis**

Biochemical processes:

**Photosynthesis** – produces food for plants.

- **Reactants (needs)-** $CO_2$, $H_2O$, light, chlorophyll
- **Products** – Glucose, $O_2$
- Occurs in the chloroplasts during the day

**Respiration** (aerobic) – produces usable energy in cells

- **Reactants (needs)**- Glucose, $O_2$
- **Products** – $CO_2$, $H_2O$, ATP
- Occurs in mitochondria all the time

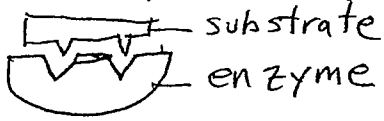
**Every living thing does respiration in order to transfer the energy in glucose to the usable form in ATP**

Not every living thing does aerobic respiration. Fermentation or anaerobic respiration is carried out by many unicellular organisms. It is not as efficient as aerobic respiration. Produces alcohol and $CO_2$.

**Enzymes –** organic catalysts

**They are proteins required by every biochemical process. Enzymes control the rate of the reactions.**

The shape of the enzyme, created by the amino acid order, makes it specific in its action.




Enzymes are affected by **pH**, **temperature** and the **concentration** of enzymes and substrates. If temp or pH is not optimal, the enzymes will be less effective. If temp is too high, the enzyme might **denature** (break down)

**Feedback**

If the internal environment of an organism changes, feedback mechanisms restore homeostasis.

**Ex. Negative feedback** – If the level of glucose gets too high, the pancreas secretes insulin to lower it. When glucose levels get too low, the pancreas stops releasing insulin and releases glucagon to increase glucose levels.

**Body temperature** regulation is another example. Your brain detects temp of your blood. If it gets low, a message is sent to muscles to contract and cause shivering. When shivering warms the blood enough, a message gets sent to stop muscle contraction.

**Plants:** Guard cells control the size of stomates. Leaf stomates allow $CO_2$ into leaves and $O_2$ and $H_2O$ out of the leaves. In drought conditions, stomates close to conserve water.

**Diseases**

**Causes:** inherited (sickle cell anemia), toxins (lead poisoning), poor nutrition (goiter-iodine deficiency), organ malfunction (heart attack, diabetes), high risk behaviors (lung cancer)

**Pathogens**: viruses, bacteria, fungi and parasites that make you sick.

**Cancer:** uncontrolled cell division

**Immune System:** your defense against disease.

**Antigens:** foreign proteins, invaders in your body.

**Your Defense:**

- **Macrophages or Phagocytes** (Pac-man White Blood Cells engulf invaders).
- **Lymphocytes –** fight against specific invaders. T-cells and B-cells are lymphocytes
- **B-cells** make **antibodies.** Antibodies are proteins that are specifically shaped to fight against an invader.
- **Helper T-cells** tell all your immune cells what to do. **HIV** infects your T-cells which weakens the immune response. People with AIDS have a very weak immune system and die of diseases that a person with a health immune system never would.
- **Killer T-cells** attack antigens directly.
- **Vaccinations –** an injection with a weakened form of the pathogen. Your immune system responds by producing antibodies against the pathogen and your memory cells remember what the pathogen looks like to be able to fight it off if you come in contact with it again.
- **Allergy –** a rapid immune system response to something that is normally harmless. Histamines are produced by your immune cells to create the symptoms of runny nose, itchy eyes, swelling.
- **Diabetes –** one type is due to the immune system killing the insulin producing cells in the pancreas.
- **Transplanted organs –** people must take medications to reduce immune response when getting a transplant or else the body will reject the organ.

**Topic 3: Genetic Continuity**

**Chromosomes** are strings of genes. Chromosomes are made of DNA.

**DNA contains the instructions for making all of your proteins**

**DNA** is made of units called **nucleotides.** Bases are complimentary **A-T, C-G.** When DNA replicates, the weak hydrogen bonds between the bases break and each strand serves as the **template** for the construction of its new compliment.

**Why is DNA important?** The order of the bases in your DNA controls the order of the amino acids in your proteins. A gene is the coded instructions for making one particular polypeptide which will become part of a protein.

A gene is transcribed into messenger RNA which leaves the nucleus. mRNA goes to a ribosome and then the codons in mRNA are translated into amino acids. Transfer RNA brings the correct amino acids to the ribosome.

**Mutation:** random changes in DNA; since the order of the bases is changed, it could cause wrong amino acids to be placed into proteins. New protein may not work right.

**Differentiation:** all your cells have the same DNA. So why are heart cells different from nerve cells? **Different genes are turned on in different kinds of cells.** This turning on and off occurs early in the development when stem cells undergo differentiation.

****The environment can affect the way genes are expressed****

**Biotechnology:**
**Genetic engineering:** humans manipulate genes in organisms
**Selective breeding:** producing desirable varieties through breeding
**Restriction enzymes:** cut DNA, allow genes to be sliced and moved to a new organism. For example, the human gene for insulin can be inserted into bacteria. These bacteria will then produce human insulin for diabetics.
**Uses:** locate genes, decode genes that cause diseases, gene therapy – change defective genes.

**Topic 4: Reproduction and Development**
**Asexual:** produce clones, one parent
**Mitosis –** cell division that creates **two identical daughter cells.**
**Sexual –** two parents, offspring is different from either parent due to recombination of genes.
**Meiosis –** making sex cells or gametes, sex cells have ½ the number of chromosomes of the original cell
**Fertilization (recombination)** joins eggs from mom with sperm from dad so that the **zygote** (fertilized egg) has 2 sets of chromosomes, one from each parent.
**Meiosis** creates variation due to crossing over and how pairs of chromosomes line up and separate.
**Meiosis→gametes(n) →fertilization→ zygote(2n)→mitosis→differentiation→ embryo**
**Female –**

- ovaries - produce estrogen, progesterone and eggs
- oviduct – site of fertilization in humans
- uterus – site of implantation and development
- placenta – forms from embryo and uterus wall; provides a place for nutrients and oxygen from the mother's blood to diffuse into the fetus' blood; waste from the fetus' blood diffuse into the mother's blood; **blood supplies never mix**
- vagina – where sperm enter; passageway for birth of the baby
- Menstrual cycle – prepares uterus for implantation if fertilization occurs; controlled by pituitary hormones (FSH & LH) and ovary hormones (estrogen and progesterone). Lining is shed if no fertilization takes place
- Ovulation – when an egg is released from the ovary and fertilization is possible (@day 14)

**Male –**

- testes – produces sperm and testosterone
- sperm duct – carries sperm to the penis
- reproductive glands – (prostate, seminal glands) produce semen to accompany the sperm
- penis – deposits sperm

**Reproductive technology** helps in agriculture, ecology (build up endangered species), and medicine

**Topic 5: Evolution**
**Living things have changed over time.**
Support: Fossil record, homologous structures, DNA and biochemical similarities.
**Organisms that are more similar to each other share a more recent common ancestor.**
**Darwin – Natural Selection**

- more are born than can survive (overproduction)
- Limited supply of resources leads to competition
- Variation exists between organisms
- The environment "selects" organisms that have favorable adaptations. An adaptation is any structure or behavior that allows an organism to get resources. Those with favorable adaptations survive, have more offspring and pass on

their traits in greater frequency to the next generation.

**If the environment changes suddenly, the organisms with traits favorable in the new environment will survive.**

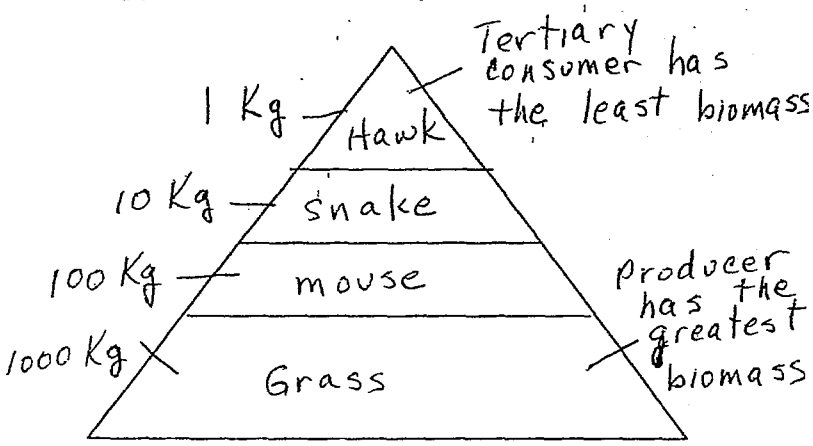
**Mutations and sexual reproduction are two major sources of variation**

**Evolution in action:** Bacterial antibiotic resistance

- Expose bacteria to an antibiotic
- Maybe one has a gene mutation making it resistant to the antibiotic
- That one resistant bacteria survives, reproduces and passes on the resistance gene
- Resistance trait increases in frequency in the next and future generations (pesticides, insecticides work the same way)

**Topic 6: Ecology** – Study of organisms in their environment
**Biotic** - living
**Abiotic** – non-living
**Habitat** – environment of a population
**Population** – one species in a particular habitat
**Community** – all populations in a habitat
**Biosphere** – everywhere life exists
**Competition** – struggle for resources
**Limiting Factors** – factors in the environment that limit population size
**Carrying capacity** – maximum number of organisms that an ecosystem can support
**Niche** – role an organism plays in an ecosystem; competition results if 2 species attempt to fill the same niche
**Producers** – provide food, autotrophs
**Heterotrophs** – consumers
**Herbivores** – eat plants; primary consumers
**Carnivores** – eat animals; secondary consumers and up
**Scavengers** – eat things that have been killed
**Decomposers** – break down dead things and return nutrients to the soil
**Parasites** – live in or on a host causing them harm

Energy and Biomass Pyramids




**Biodiversity** – measurement of the degree to which organisms vary in an ecosystem

- leads to stable environments
- loss of biodiversity leads to upsetting the balance of ecosystems
- taking out one population has an effect on others
- ensures genetic variability
- provides resources like medicines

**Succession** – series of changes by which one habitat changes into another

- **pioneer species** – the first species to occupy an area
- **climax community** – the stable ecosystem that is formed over time and will remain unless there is a huge environmental change

**Topic 7: Human Impact**
Humans need to have an understanding of ecology because we have the ability to modify the environment. Our activities can create problems.

- **Renewable resources** – can be replaced (trees)
- **Non-renewable** – cannot be replaced (fossil fuels)

**Reduce – Reuse – Recycle**
**Pollution** – leads to poor air, water, soil quality
**Population growth** – human population has grown exponentially – creates many environmental problems
**Direct Harvesting** – removing species from habitats; can lead to **extinction**

**eforestation** – destroys habitats; ·ovides resources with a huge cost to the )ecies living in these habitats; **reduces iodiversity**

**nported species** – become pests when ey are introduced to an area with no atural predators (ex. gypsy moth)

**ndustrialization** – leads to pollution

- nuclear waste
- toxic waste
- thermal pollution
- air pollution

**urning fossil fuels** releases **carbon ioxide** into the air. **Carbon dioxide** is a eenhouse gas which traps heat in our mosphere leading to **global warming.** lobal warming could lead to the melting polar ice caps leading to flooding. Plant ees to reduce global warming. Burning ssil fuels also release **sulfur and itrogen** into the air which leads to acid ain.

**zone depletion** is due to the release of emicals (CFC's) into the atmosphere hich breaks down ozone. The reduction ozone leads to an increase in **UV adiation** hitting the earth surface leading increase in cancer.

**opic 8: Science and Inquiry**

**bservations** – use tools or senses to bserve the natural world

**nference** – a conclusion based on an bservation (if you watch a slug for an our and it does not move, you may infer at it is dead)

**ssumption** – a belief that something is ue

**pinion** – ideas that people have cientific literacy involves applying critical inking to everyday life.

nderstanding the scientific method llows you to be a critical thinker

- How was the testing done?
- How many subjects were used?
- What controls were used?

hese are just a few questions that need be asked about every study.

**lypothesis:** worded as...

**If ... then**

Ex. If I add a hormone to plant leaves then the leaves will grow faster.

**Dependent Variable:** what you are measuring.

Ex: the length of the leaves

Always on the y-axis

**Independent Variable:** factor that influences the dependent variable

Ex: concentration of hormone, how often it is applied

Always on the x-axis

**Controlled Experiment:** making sure that the only difference is the one variable that you are testing for. A **control group** does not get the experimental variable applied to it in order to act as the basis for comparison.

Ex: a plant with no hormone added would be the control plant. It gets everything else the same as all the plants being used (same amt. of water, soil, light, etc.). A large number of samples (Ex. a lot of plants) lead to more accurate results.

**Data:** graphs, tables, charts are used to visualize, organize, represent data (measurements).

**Tables:**

- Organize columns to relate independent to dependent variables. Ex: The Effect of Plant Hormone (Ind. variable) on Leaf Growth (Dep. variable)
- Usually the independent variable is recorded and organized in ascending order
- Headings for columns must have UNITS!

**Graphs:**

- Label axes with headings and units
- Figure out an appropriate scale
- Independent = x-axis
- Dependent = y-axis
- The spacing between numbers on axes **must** be in equal increments
- Plot points carefully, surround with a circle or triangle as directed
- Connect points
- DO NOT extend the line beyond the points

**Conclusions:** was the hypothesis supported?
**The experiment must be repeatable and similar results obtained in order for the results to be reliable.**

**Topic 9: Lab Skills**
**Length:** ruler USE THE METRIC SYSTEM!
1 mm = 1,000 um (micrometers)
**Mass:** balance (scale)
**Volume:** graduated cylinder
**Microscope:** Compound Light

- eyepiece (ocular)
- Objective lenses – magnify
- stage - holds sample
- diaphragm – controls light
- coarse adjustment – use under low power ONLY
- fine adjustment – use under high power

**Stain:** use stain (methylene blue, iodine) to see cell parts clearly.
What can you see?
Nucleus, cell (plasma) membrane, cell wall, chloroplasts, vacuoles, cytoplasm, chromosomes in dividing cells.
**Electrophoresis:** separates segments of DNA or proteins according to size.
**Chromatography:** separates pigments based on solubility in a solvent
**Indicators:** chemicals that test for the presence of a substance. Indicators undergo a color change if positive.
**Dichotomous Keys:** for classification; specimens sorted according to common characteristics.
**Dissection:** allows you to compare organisms and understand structure and function
**Safety:** Goggles, gloves, know where safety equipment is, follow directions, point test tubes away from yourself and others, pull back hair and loose clothing, and do not put rubber stoppers on test tubes when heating.