What is the number of the parking spot?
UNIT 1: WELLNESS AND HOMEOSTASIS
WHAT IS THE DIFFERENCE BETWEEN HEALTH AND WELLNESS?
5 FACTORS OF WELL-BEING

• PHYSICAL
• EMOTIONAL
• SPIRITUAL
• INTELLECTUAL
• SOCIAL
8 Dimensions of Wellness
What Number will replace question mark?
WHAT IS BIOLOGY?

• BIOLOGY IS THE STUDY OF ________________ LIVING THINGS

• “BIO” = ____________, “OLOGY”= A SUBJECT OF ___________ STUDY

• BROAD DISCIPLINE DUE TO THE WIDE VARIETY OF ORGANISMS ON THE PLANET

• IN THIS COURSE, YOU WILL LEARN MORE ABOUT THE ________________ HUMAN ORGANISM. YOU WILL STUDY THE STRUCTURE OF THE HUMAN BODY (__________________) AND ALSO HOW THE HUMAN BODY WORKS (__________________). THESE TWO AREAS—STRUCTURE AND FUNCTION—are closely related.
• **CELLS** ARE THE BASIC UNIT OF LIFE.

• **GENES** ARE THE BASIC UNITS FOR PASSING TRAITS FROM PARENT TO OFFSPRING.

• **EVOLUTION** HAS LED TO THE GREAT DIVERSITY OF SPECIES ON EARTH.

• LIVING THINGS **MAINTAIN** THE ENVIRONMENT WITHIN THEIR CELLS AND BODIES.

• LIVING THINGS HAVE THE ABILITY TO ACQUIRE AND TRANSFORM **ENERGY**.
LEVELS OF ORGANIZATION

- Specialised cell
- Muscle tissue
- Heart
- Circulatory system
- Organism

Muscle cell makes up part of the human body.
MOLECULES OF LIFE

• ALL LIFE ON EARTH IS BUILT FROM FOUR DIFFERENT TYPES OF MOLECULES. THESE MOLECULES ARE OFTEN REFERRED TO AS BIOMOLECULES.
  • CARBOHYDRATES
  • LIPIDS
  • PROTEINS
  • NUCLEIC ACIDS
• WITHOUT THESE FOUR MOLECULES, A CELL AND ORGANISM WOULD NOT BE ABLE TO LIVE.
Organic Compounds: Biomolecules

Level 4: The cell and its organelles
Level 3: Supramolecular complexes
Level 2: Macromolecules
Level 1: Monomeric units

DNA
Nucleotides
Amino acids
Protein
Cellulose
Sugars
Carbohydrate Isomers

Glucose

Galactose

Fructose
Biomolecule Bros!
WELLNESS

• WELLNESS IS NOT THE SAME AS HEALTH.

• HEALTH GENERALLY REFERS ONLY TO THE PHYSICAL WELL-BEING OF AN INDIVIDUAL

• WELLNESS REFERS TO THE MULTIDIMENSIONAL INTERRELATIONSHIP BETWEEN THE FIVE FACTORS OF WELL-BEING:
  
  Physical
  Emotional
  Social
  Intellectual
  Spiritual
HOMEOSTASIS

• THE BODY’S ATTEMPT TO MAINTAIN A STABLE INTERNAL ENVIRONMENT

• EX: WHAT DOES THE BODY DO WHEN...

  • IT’S -30°C OUTSIDE? _________________________________ YOU SHIVER
  • IT’S +35°C OUTSIDE? _________________________________ YOU SWEAT
  • YOU GO FOR A RUN? _________________________________ YOU SWEAT, BREATHE HEAVILY, HEART RATE INCREASES
HOMEOSTASIS

- In order to function properly, homeostatic mechanisms are required to:
  1. Regulate respiratory ___________ gases (e.g. oxygen)
  2. Maintain _______ water and _______ salt balance (e.g. electrolytes)
  3. Regulate _______ energy / _______ nutrient supply (e.g. blood sugar)
  4. Maintain constant body ___________ temperature
  5. Protect against _______ pathogens
  6. Make _______ repairs when injured
QUICK RESEARCH

- BODY TEMPERATURE
- BLOOD PH
- RESTING HEART RATE
- BLOOD PRESSURE
- BLOOD SUGAR (FASTING)
DYNAMIC EQUILIBRIUM

• HOMEOSTASIS IS OFTEN REFERRED TO AS A DYNAMIC EQUILIBRIUM - Which is a mechanism to ensure that all body systems function within an acceptable range to sustain life.

• DYNAMIC EQUILIBRIUM ➔ A CONDITION THAT REMAINS STABLE WITHIN FLUCTUATING LIMITS.

• THE BODY WORKS BEST AT SPECIFIC SET POINTS (TEMPERATURE 37°C, BLOOD PH NEAR 7.4, ETC.)
<table>
<thead>
<tr>
<th>Measurement site</th>
<th>Mouth / armpit</th>
<th>Ear / forehead</th>
<th>Rectum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low temperature</td>
<td>&lt; 35.8</td>
<td>&lt; 35.7</td>
<td>&lt; 36.2</td>
</tr>
<tr>
<td>Normal temperature</td>
<td>35.9 - 37.0</td>
<td>35.8 - 36.9</td>
<td>36.3 - 37.5</td>
</tr>
<tr>
<td>Increased temperature</td>
<td>37.1 - 37.5</td>
<td>37.0 - 37.5</td>
<td>37.6 - 38.0</td>
</tr>
<tr>
<td>Light fever</td>
<td>37.6 - 38.0</td>
<td>37.6 - 38.0</td>
<td>38.1 - 38.5</td>
</tr>
<tr>
<td>Moderate fever</td>
<td>38.1 - 38.5</td>
<td>38.1 - 38.5</td>
<td>38.6 - 39.0</td>
</tr>
<tr>
<td>High fever</td>
<td>38.6 - 39.5</td>
<td>38.6 - 39.4</td>
<td>39.1 - 39.9</td>
</tr>
<tr>
<td>Very high fever</td>
<td>39.6 - 42.0</td>
<td>39.5 - 42.0</td>
<td>40.0 - 42.5</td>
</tr>
</tbody>
</table>

Consult a doctor.
You are perfectly well.
You should get some rest.
Check your temperature regularly and rest.
Check your temperature regularly. Consult a doctor if you get worse or if the fever lasts for more than three days.
Consult a doctor, especially if the fever lasts for more than one day.
Go to emergency ward of a hospital!
A clerk at a butcher shop stands five feet ten inches tall and wears size 13 sneakers. What does he weigh?
fluctuate

/ˈflʌktʃuət/ (pronounced: /ˈflʌktʃuət/)

verb

rise and fall irregularly in number or amount.

"trade with other countries tends to fluctuate from year to year"

synonyms: vary, change, differ, shift, alter, waver, swing, oscillate, alternate, rise and fall, go up and down, seesaw, yo-yo, be unstable

"profits fluctuate from month to month"
NEGATIVE FEEDBACK MECHANISMS

- A FEEDBACK IN WHICH THE SYSTEM Responds IN AN **OPPOSITE** DIRECTION TO THE DISTURBANCE.

- YOUR BODY Responds IN SUCH A WAY TO **REVERSE** THE CHANGE THAT IS HAPPENING.

- NEGATIVE FEEDBACK IS THE PRIMARY HOMEOSTATIC MECHANISM THAT OUR BODIES USE.

FEEDBACK: A RESPONSE WITHIN A SYSTEM THAT AFFECTS THE CONTINUED ACTIVITY OF THAT SYSTEM
NEGATIVE FEEDBACK MECHANISMS

• INVOLVES 3 COMPONENTS:
  • **SENSOR/RECEPTOR**: RECEIVES INFORMATION/STIMULUS ABOUT A CHANGE IN THE ENVIRONMENT, SENDS INFORMATION TO CONTROL CENTRE
  • **CONTROL CENTRE**: DETERMINES AN APPROPRIATE RESPONSE TO THE STIMULUS AND SENDS SIGNAL TO EFFECTOR
  • **EFFECOR**: CREATES A RESPONSE THAT CHANGES CONDITIONS IN THE INTERNAL ENVIRONMENT TO RESTORE BALANCE
Example:
Temperature in house set to 20°C. Internal house temperature drops to 17°C. Thermostat detects drop in temperature. Thermostat turns on furnace. Furnace starts and begins to warm house. Temperature returns to 20°C.
THERMOREGULATION

• THE MAINTENANCE OF A CONSTANT BODY TEMPERATURE (37°C IN HUMANS)
HEAT STRESS

• THERMORECEPTORS DETECT AN **INCREASE** IN BODY TEMPERATURE, SEND MESSAGE TO **CONTROL CENTRE**

• HYPOTHALAMUS SIGNALS TO THE **SWEAT** GLANDS TO INITIATE SWEATING

• EVAPORATION OF THE SWEAT OFF THE SKIN CAUSES COOLING.
HEAT STRESS

• The hypothalamus also sends message to **blood** vessels in the skin causing them to **dilate**. → VASODILATION
  
• Dilation allows for more blood flow to the skin.

• Heat from the blood is lost to the skin so blood can return to core of your body & cool the internal organs.
COLD STRESS

• THERMORECEPTORS DETECT A **DECREASE** IN BODY TEMPERATURE, SEND MESSAGE TO HYPOTHALAMUS

• HYPOTHALAMUS SENDS A MESSAGE VIA THE NERVES TO THE SKELETAL **MUSCLES** MAKING THEM CONTRACT CAUSING **SHIVERING**

  • MOVEMENT OR SHIVERING GENERATES **HEAT**
COLD STRESS

• THE HYPOTHALAMUS ALSO SENDS MESSAGE TO BLOOD VESSELS IN THE SKIN CAUSING THEM TO **CONSTRIC** → **VASOCONSTRICTION**

• REDUCES HEAT LOSS FROM THE SKIN AND RETAINS HEAT IN THE BODY.

• SMOOTH MUSCLES AROUND HAIR FOLLICLES CONTRACT CAUSING THE HAIR TO “STAND ON END” TRAPPING WARM AIR.
IN THERMOREGULATION, WHAT IS/ARE THE:

• SENSORS/RECEPTORS?
  
  THERMORECEPTORS IN SKIN

• CONTROL CENTRE?
  
  HYPOTHALAMUS (BRAIN)

• EFFECTORS?
  
  SWEAT GLANDS, HAIR FOLLICLES, BLOOD VESSELS, MUSCLES
Body temperature falls

Blood vessels constrict so that heat is conserved. Sweat glands do not secrete fluid. Shivering (involuntary contraction of muscles) generates heat, which warms the body.

Normal body temperature

Heat is retained

Body temperature rises

Blood vessels dilate, resulting in heat loss to the environment. Sweat glands secrete fluid. As the fluid evaporates, heat is lost from the body.

Heat is lost to the environment
OSMOREGULATION

• THE MAINTENANCE OF A CONSTANT **WATER BALANCE** IN THE BODY.

• THE HYPOTHALAMUS CONTROLS (WITH HORMONES) INCREASED ABSORPTION OF WATER AS WELL AS THIRST.

• WE TAKE IN MOST OF OUR WATER FROM FOOD OR DRINK, AND WE LOSE WATER BY **URINATING**, **DEFACATING** AND **EVAPORATION** (BREATHING AND SWEATING).
OSMOREGULATION

• REGULATION OF WATER IS IMPORTANT BECAUSE OUR CELLS CANNOT SURVIVE A NET GAIN OR LOSS OF WATER.
  • A LOSS OF 1% OF OUR BODY FLUID CAUSES _________ THIRST
  • A LOSS OF 5% OF OUR BODY FLUID RESULTS IN EXTREME _________ PAIN OR COLLAPSE
  • A LOSS OF 10% OF OUR BODY FLUID CAN CAUSE ___________ DEATH
Water content of blood too low:
- Salt eaten or much sweating
- Pituitary releases lots of ADH
- High volume of water passes into blood
- High volume of water reabsorbed by kidney
- Small volume of concentrated urine passed to the bladder

Water content of blood too high:
- Too much water drunk
- Pituitary releases little ADH
- Low volume of water passes into blood
- Low volume of water reabsorbed by kidney
- High volume of dilute urine passed to the bladder
IN OSMOREGULATION, WHAT ARE/IS THE:

• SENSORS/RECEPTORS?
  **OSMORECEPTORS IN HYPOTHALAMUS**

• CONTROL CENTRE?
  **PITUITARY GLAND (BRAIN)**

• EFFECTORS?
  **KIDNEYS**
WASTE MANAGEMENT

• THE ABILITY OF THE BODY TO RID ITSELF OF HARMFUL WASTE.

• THE KIDNEYS, LIVER, LUNGS, SKIN, AND STOMACH ARE INVOLVED IN THE ELIMINATION OF VARIOUS WASTE PRODUCTS.

• THIS WILL BE COVERED FURTHER IN A LATER UNIT.
A man was born in 1995 and died in 1953. How is this possible?
• [HTTPS://WWW.YOUTUBE.COM/WATCH?V=IZ0Q9NTZCW4](HTTPS://WWW.YOUTUBE.COM/WATCH?V=IZ0Q9NTZCW4)

• GO OVER THERMOREGULATION LOOPS

• CREATE 2 FEEDBACK LOOPS FOR OSMOREGULATION (TOO MUCH WATER, TOO LITTLE WATER)
LIFE PROCESSES

- Complex organisms need to carry out the following six life processes:
  - Obtain __FOOD__
  - Convert __ENERGY__
  - Eliminate __WASTES__
  - Reproduce
  - Grow & Repair
  - Transport __substances__

- Individual cells must also carry out __all__ of these life processes
THE CELL THEORY

THE MODERN CELL THEORY HAS THREE MAIN PRINCIPLES:

1. ALL ORGANISMS ARE COMPOSED OF ONE OR MORE __________.
2. CELLS ARE THE __________________ OF STRUCTURE AND ORGANIZATION OF ORGANISMS.
3. CELLS ARISE BY THE DIVISION OF __________ CELLS.

BASIC UNIT
PRE-EXISTING
TWO BASIC CELL TYPES

• 1. ________________________
  PROKARYOTIC
  CELLS
• NO TRUE NUCLEUS
• LACKS MEMBRANE-BOUND
  ORGANELLES
• E.G. _________________  
  BACTERIA
TWO BASIC CELL TYPES

• 2. ________________________________ CELLS

• HAVE A TRUE ___________________________

• CONTAIN MEMBRANE-BOUND ORGANELLES, THEREFORE, CELL
  FUNCTIONS ARE SEPARATED INTO DISTINCT COMPARTMENTS AND CAN BE
  CARRIED OUT SIMULTANEOUSLY.

• E.G. FUNGUS, PLANTS, ANIMALS
ALL LIVING CELLS POSSESS SUCH A MEMBRANE WHICH SERVES AS ITS BOUNDARY WITH THE EXTERNAL ENVIRONMENT.

SELECTIVELY PERMEABLE OR SEMI-PERMEABLE

THIS MEANS IT ALLOW THE PASSAGE OF CERTAIN MOLECULES WHILE BLOCKING OTHERS
A Cell in Fluid

Magnified Cell Membrane
FOUR MAIN FUNCTIONS OF CELL MEMBRANE

1. THIN, MOLECULAR LAYER THAT **SURROUNDS** ALL LIVING CELLS

2. **SEPARATES** THE CELL FROM ITS EXTERNAL ENVIRONMENT

3. **PROTECTS** THE CELL FROM CHANGES IN THE CHEMICAL AND PHYSICAL ENVIRONMENT
FOUR MAIN FUNCTIONS OF CELL MEMBRANE

4. REGULATES THE TRAFFIC OF MOLECULES **INTO** AND **OUT** OF THE CELL:

- PREVENTS **UNWANTED** MATERIALS FROM ENTERING
- TRANSPORTS RAW MATERIALS INTO CELL
- TRANSPORTS MANUFACTURED PRODUCTS AND **WASTES** OUT OF CELL
- PREVENTS ESCAPE OF MATTER NEEDED TO PERFORM CELLULAR FUNCTIONS
CELL MEMBRANE

• COMPOSED PRIMARILY OF TWO TYPES OF MOLECULES:
  • __________ – LIPIDS – FATTY & OILY MOLECULES
  • __________ – PROTEINS
PHOSPHOLIPID BILAYER STRUCTURE

- TWO SHEETS OF LIPIDS (PHOSPHOLIPIDS), EACH SHEET A SINGLE MOLECULE THICK.
  - THEY CONTAIN A PHOSPHATE GROUP, CALLED THE ________, AND TWO CHAINS OF FATTY ACID, CALLED THE ________.
  - HYDROPHILIC = WATER ________ LOVING
  - HYDROPHOBIC = WATER ________ FEARING
Phosphate group

Fatty acid

Phospholipid Bilayer

Hydrophilic
- Soluble (able to dissolve) in water
- Polar molecule

Hydrophobic
- Repel water
- Non-polar molecule
FLUID MOSAIC MODEL

• The cell membrane is composed of a double layer (bilayer) of **phospholipids** into which **protein** molecules are embedded.

• Proteins are responsible for:
  - **transporting** substances across the membrane
  - Aiding **communication** between cells
  - Carrying out **chemical** reactions
FLUID MOSAIC MODEL

• IT IS “FLUID” BECAUSE IT IS __________________ – THE PHOSPHOLIPIDS AND PROTEINS MOVE WITHIN THE MEMBRANE

• IT IS “MOSAIC” BECAUSE THE PROTEINS CREATE A ‘____________’ ON THE MEMBRANE SURFACE
THE CELL MEMBRANE AND HOMEOSTASIS

• CONDITIONS INSIDE EVERY CELL MUST REMAIN NEARLY **CONSTANT** FOR IT TO KEEP PERFORMING ITS LIFE FUNCTIONS

• THE **CELL MEMBRANE** IS RESPONSIBLE FOR MAINTAINING HOMEOSTASIS.

• DUE TO **SELECTIVE PERMEABILITY**, THE CELL MEMBRANE CONTROLS WHAT GOES IN AND OUT OF THE CELL

• IN A MULTICELLULAR ORGANISM, EVERY CELL IS BATHED IN A THIN LAYER OF **EXTRACELLULAR** FLUID, CONSISTING OF WATER AND OTHER MATERIALS
  • CONTAINS SUBSTANCES THAT CELLS NEED AND WASTE THAT CELLS HAVE DISCARDED
# VOCABULARY QUIZ - MONDAY

<table>
<thead>
<tr>
<th>Term</th>
<th>Description</th>
<th>Term</th>
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</thead>
<tbody>
<tr>
<td>Homeostasis</td>
<td>Negative feedback</td>
<td>Osmoregulation</td>
</tr>
<tr>
<td>Wellness</td>
<td>sensor/receptor</td>
<td>Semi-permeable</td>
</tr>
<tr>
<td>Lipid</td>
<td>Control centre</td>
<td>Phospholipid bilayer</td>
</tr>
<tr>
<td>Carbohydrate</td>
<td>Effector</td>
<td>Extracellular fluid</td>
</tr>
<tr>
<td>Protein</td>
<td>Thermoregulation</td>
<td>Passive transport</td>
</tr>
<tr>
<td>Nucleic acid</td>
<td>Vasodilation</td>
<td>Diffusion</td>
</tr>
<tr>
<td>Negative</td>
<td>Vasoconstriction</td>
<td>Concentration gradient</td>
</tr>
<tr>
<td>Isotonic</td>
<td>Active transport</td>
<td>Osmosis</td>
</tr>
<tr>
<td>Hypertonic</td>
<td>Hypotonic</td>
<td></td>
</tr>
</tbody>
</table>
**SOLUTE**
Substance dissolving

**SOLVENT**
Liquid the solute dissolves in

**SOLUTION**
Solute dissolved in solvent
PASSIVE TRANSPORT

• DOES NOT REQUIRE _________. MOVES ________ CONCENTRATION GRADIENT.

Concentration Gradient

• The concentration gradient is the distribution of particles across space from high to low concentration
1. DIFFUSION

• MOVEMENT OF MOLECULES (E.G. OXYGEN) FROM A REGION IN WHICH THEY ARE HIGHLY CONCENTRATED TO A REGION IN WHICH THEY ARE LESS CONCENTRATED
1. DIFFUSION

- MOLECULES MOVE ACROSS THE MEMBRANE THROUGH PORES
- CONTINUES UNTIL THE MOLECULES INVOLVED ARE \textbf{EQUAL} DISTRIBUTED THROUGHOUT THE SYSTEM ON BOTH SIDES OF THE MEMBRANE. THE SYSTEM IS THEN SAID TO BE IN \textbf{EQUILIBRIUM}
2. OSMOSIS

• MOVEMENT OF WATER MOLECULES FROM A REGION OF HIGHER CONCENTRATION TO A REGION OF LOWER CONCENTRATION.

• WATER WILL MOVE TOWARD A HIGH CONCENTRATION OF SOLUTE AND HENCE A LOWER CONCENTRATION OF WATER.
2. OSMOSIS

**ISOTONIC CONDITIONS**: There is the same solute concentration inside and outside the cell. Equal amounts of water move in and out of the cell.
2. OSMOSIS

- **HYPOTONIC CONDITIONS**: SOLUTION HAS LESS SOLUTE THAN THE CELL. A CELL PLACED IN THIS SOLUTION WILL TAKE UP WATER AND SWELL.
2. OSMOSIS

- **HYPERTONIC CONDITIONS**: SOLUTION HAS MORE SOLUTE THAN THE CELL. A CELL PLACED IN THIS SOLUTION WILL GIVE UP WATER AND SHRINK.
3. FACILITATED DIFFUSION

- MOVEMENT OF MOLECULES TOO **LARGE** TO PASS THROUGH THE LIPID BILAYER ON THEIR OWN (E.G. **GLUCOSE**).
- MOVEMENT IS FROM A REGION OF HIGH CONCENTRATION TO LOW CONCENTRATION AND IS ASSISTED BY **PROTEINS**.
ACTIVE TRANSPORT

• REQUIRES ADDITIONAL ENERGY (ATP). MOVES UP CONCENTRATION GRADIENT.

• CARRIES MOLECULES FROM AREAS OF LOW CONCENTRATION TO HIGH CONCENTRATION USING TRANSPORT PROTEINS IN THE CELL MEMBRANE.
Passive Transport

Active Transport

this is easy!

this is hard work
ACTIVE TRANSPORT

1. PROTEIN PUMPS

- PERMITS THE CELL TO COLLECT CERTAIN SUBSTANCES IN HIGH CONCENTRATION (E.G. NUTRIENTS)

- ALLOWS CELLS TO GET RID OF _______ TOXIC _______ WASTE SUBSTANCES
2. ENDOCYTOSIS/EXOCYTOSIS

- SOMETIMES SUBSTANCES ARE TOO LARGE TO MOVE THROUGH THE LIPID LAYER OR THROUGH PROTEIN CARRIERS.

**Exocytosis:** a vesicle forms around the unwanted substances and fuses with the cell membrane; the contents are secreted into the extracellular fluid.

**Endocytosis:** cell membrane folds inward, trapping and enclosing substances from the extracellular fluid.
FACTORS THAT AFFECT MOVEMENT ACROSS THE CELL MEMBRANE

• **SIZE**: SMALL MOLECULES CAN MOVE THROUGH THE CELL MEMBRANE BY DIFFUSION. LARGER MOLECULES CANNOT MOVE THROUGH BY DIFFUSION, EVEN IF THERE IS A STRONG CONCENTRATION GRADIENT.
FACTORS THAT AFFECT MOVEMENT ACROSS THE CELL MEMBRANE

- **Polarity**: Determines how easily the molecule can pass through the cell membrane.
  - Non-polar tails repel charged molecules or ions (charged atoms)
  - Ions require channels
FACTORS THAT AFFECT MOVEMENT ACROSS THE CELL MEMBRANE

- **TEMPERATURE**: MOLECULES IN A SYSTEM AT A **HIGHER** TEMPERATURE WILL HAVE MORE **ENERGY** AND WILL MOVE AND DIFFUSE **FASTER**.

FACTORS THAT AFFECT MOVEMENT ACROSS THE CELL MEMBRANE

- **CONCENTRATION**: THE **HIGHER** THE CONCENTRATION GRADIENT, THE **FASTER** THE RATE OF DIFFUSION
FACTORS THAT AFFECT MOVEMENT ACROSS THE CELL MEMBRANE

- **SURFACE AREA**: The larger the surface area over which diffusion can occur, the greater the rate of diffusion.
• Cells are limited in size because the cell membrane must transport the food and oxygen to the parts inside. As a cell gets bigger, the outside is unable to keep up with the inside, because the inside grows at a faster rate than the outside.

• Represented by the surface to volume ratio, or S: V.

• In a cell that is one unit in size, the surface area is 6 square units and the volume is 1 cubic unit. The ratio then is 6:1. As a cell gets larger, this ratio gets smaller, meaning the cell membrane cannot supply the inside with what it needs to survive.
**Why cells are small and organisms are made up of cells!**

<table>
<thead>
<tr>
<th></th>
<th>Total surface area (height × width × sides × number of boxes)</th>
<th>Total volume (height × width × length × number of boxes)</th>
<th>SA:Vol ratio (surface area ÷ volume)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>6</td>
<td>1</td>
<td>6</td>
</tr>
<tr>
<td>5</td>
<td>150</td>
<td>125</td>
<td>1.2</td>
</tr>
<tr>
<td>750</td>
<td></td>
<td>125</td>
<td>6</td>
</tr>
</tbody>
</table>

SA increases, volume stays constant
HOW DO LIVING CELLS ACQUIRE ENERGY?

• WE’VE SEEN IN THE PREVIOUS LEARNING EXPERIENCE THAT THE CELL USES ENERGY DURING ACTIVE TRANSPORT. WHERE DOES THIS ENERGY COME FROM?

• THE ULTIMATE SOURCE OF ALL ENERGY ON EARTH IS THE __________. 

SUN
PHOTOSYNTHESIS

• Plants use the sun’s energy to convert **carbon dioxide** and **water** into food, in the form of **carbohydrates** and **oxygen**.

• It is the pigment **chlorophyll** that allows plants to convert radiant energy from the sun into chemical energy in the molecules that they produce.
CELLULAR RESPIRATION

• ANIMALS CANNOT MAKE THEIR OWN FOOD; THEY MUST CONSUME PLANTS OR OTHER ANIMALS.

• WHEN ANIMALS EAT FOOD, THEY BREAK DOWN THOSE FOOD MOLECULES BY BREAKING THE BONDS WITHIN THEM. WHEN THESE BONDS ARE BROKEN, ENERGY IS RELEASED.
ENERGY STORAGE

- BEFORE ENERGY CAN BE USED IN LIVING SYSTEMS, IT IS FIRST TRANSFORMED INTO A FORM WHICH THE ORGANISM CAN STORE. THIS SPECIAL CARRIER OF ENERGY IS THE MOLECULE **ADENOSINE TRIPHOSPHATE (ATP)**.
- **GLUCOSE** AND OTHER MOLECULES ARE BROKEN DOWN, MAINLY IN THE **MITOCHONDRIA** OF CELLS, PRODUCING ATP.
ENERGY STORAGE

• WHEN ENERGY IS NEEDED, ATP WORKS BY LOSING THE ENDMOST PHOSPHATE GROUP WHEN INSTRUCTED TO DO SO BY AN ENZYME.

• THE BROKEN BOND RELEASES ENERGY. THE REACTION PRODUCT IS ADENOSINE DIPHOSPHATE (ADP).
ENERGY STORAGE

• WHEN THE ORGANISM IS RESTING AND ENERGY IS NOT IMMEDIATELY NEEDED, THE REVERSE REACTION TAKES PLACE AND THE PHOSPHATE GROUP IS REATTACHED TO THE MOLECULE USING ENERGY OBTAINED FROM FOOD.

• THUS THE ATP MOLECULE ACTS AS A "RECHARGEABLE BATTERY" MOLECULE, STORING ENERGY WHEN IT IS NOT NEEDED, BUT ABLE TO RELEASE IT INSTANTLY WHEN THE ORGANISM REQUIRES IT.