bound to them. The pocket breaks off into the cell and forms a vesicle. <u>Difference from the rest of the Endocytosis because it is specific.</u>

i. Cholesterol is carried through your blood via LDL (protein). Cell has LDL receptors that bind LDL with the cholesterol. As a result, the cholesterol is brought into your cell.

1. Disease – Familial Cholesterolemia → missing many of their LDL receptors which causes clots and heart attack.

<u>Energy</u>

Sun – the source of all energy

Law of Conservation of energy – energy cannot be created nor destroyed (solar energy goes to plants, converted in photosynthesis, produces glucose, we eat the glucose and use the energy)

- Energy can be converted from one form to another
- **Energy** – the ability to do work (Chemical, potential ...)
- **Chemical Energy** – the energy required for chemical reactions → change matter from one form to another. → = chemical change (product)
- **Potential Energy** – stored energy, everything on earth has potential energy (potential to fall …). We store energy in carbs and lipids (also glycogen).
- **Kinetic Energy -** energy of motion → Brownian motion of our molecules
- **How does energy get into your body through glucose?** Plants use solar energy for photosynthesis and the energy is stored in the covalent bonds in the glucose (potential energy). You then have to burn the glucose. Then the burnt energy becomes ATP by Cellular Respiration. ATP is the energy currency of cells and when ATP starts working it is kinetic energy but it still stores energy. (Think of it like the bank = storage, and the ATP Is the cash put into the candy machine.
- **ATP** - Adenosine Triphosphate – nitrogenous base = adenine connected to a sugar (ribosome) connected to 3 bases.
- After an ATP is used (phosphate breaks via hydrolysis and releases energy) then it can recharge → ADP → AMP – once a phosphate breaks off.
- Your body uses and makes ATP all the time.
- **Why do you need so much energy in your body?** 1000's of chemical reactions taking place all the time. It also happens pretty slowly and could take 100 years but then there are enzymes that speed up chemical reactions from 100 years → one second.
    - in order to have a chemical reaction:
        1. molecules must find each other (kinetic energy) – due to Brownian motion

2. No density dependent inhibition – as cells grow the more dense they become they send signals not to divide but cancer cells don't have that so they divide even when they are surrounded by cells. – **Tumor** – clump of cells (abnormal), **Benign Tumor** – not harmful tumor – doesn't invade any organ. **Malignant Tumor** – invades an organ and prevents it from functioning properly.
3. No anchorage dependence – cells usually need a surface to attach to before they grow but cancer cells do not need a surface, they just develop and divide wherever.

   Metastasis – cancer cells travel from one site to another (spread throughout the body)

In 1951, Henrietta Lacks had Cervical Cancer and had her tumor removed – the tumor is living till today/ immortal. They were called **HeLa cells**.

Cancer, even with a mistake, will continue to grow.

Treatments

1. Chemotherapy – very strong drugs that target actively dividing cells (Cancer, hair cells).
   a. **Taxol** – prevents microtubules from breaking apart from each other (can't continue growing after Anaphase)
2. Radiation – zapping a tumor with radiation → radiation kills cells
3. Surgical removal of Tumor

Lab

Whitefish Blastula – embryotic cells are actively dividing (growing)

Onion cell – cations

Looking for nucleus with nucleoli in it ... Interphase

Telophase… cell plate

Longest – more cells in that phase – Interphase 🍇

Meiosis = Gamete production

- Gamete = sperm and egg
- Sperm or egg – 23 chromosomes
- Sperm + egg = fertilization
- **Zygote** – fertilized egg
  - Zygote → many cycles of mitosis → embryo → fetus → baby

Meiosis – process to make gametes

Germ cell - cell that divides to form sperm/ egg.

46 → meiosis → 23 gametes

1. **Embryonic Stem Cells** – found in embryo, it can divide into any type of cell. It's used to help cure many problems yet became a political issue because of Abortions.
2. **Adult Stem Cells** – in bone marrow – produces all blood cells → more specialized (just blood)

<u>**Molecular Biology**</u>

Genetic material = Heredity … What do we pass on to Offspring? What is their Genetic Identity?

- 1928 – England – **Frederick Griffith** → vaccine for streptococcus pneumonia

  Vaccines – weakened the bacteria (strain)/ killed the bacteria. He worked with 2 strains of Streptococcus pneumonia

  1. **Virulent** – disease causing (S strain – smooth)
  2. **Avirulent** – non-disease causing (R strain – rough), it lacked a smooth capsule that would surround the bacterial cell wall.

  Steps he took:

  1. Grew R+S bacteria
  2. Injected R bacteria into living mouse → it lived
  3. Injected S bacteria into mouse → it died
  4. Took S strain and heated it up (breaking the capsule and membrane) and injected into mouse → mouse lived
  5. Heat inactivated S strain and mixed with R strain killed the mouse.

     Why?

     - The inactivated S contained virulent genetic material that was released when the capsule and membrane broke open. The R cell was transformed into Virulent bacteria.

Oswald Avery – 1944 Rockefeller University

- He wanted to repeat the Griffith experiment and find the transforming factor (we know is DNA). He did this in Vitro (in a test tube). He took the R cells and S cells made them into juice. He systematically took each content out of the cell to see if the cell would transform.

  His Experiment:

  1. Inactivated heat killed S cells and adds Rnase (enzyme) to extract RNA. Mixed this in with R cells. The R cells transformed into S so we learn that RNA is not the transformation factor.

indicate where the gene is located and recruits RNA polymerase which causes RNA polymerase to bind at the promoter.

2. **Elongation** – RNA polymerase untwists the DNA at the promoter and begin adding complementary RNA bases. **Sense strand** the strand we don't replicate, **Anti-sense strand** we replicate for RNA.

   You copy the DNA → RNA; by switching to RNA bases and while it is getting copies, the RNA strand falls off. RNA polymerase is in charge of adding these bases.

3. **Termination** – the RNA polymerase reaches the Terminator sequence (stops)

   a. RNA polymerase falls off the DNA

   b. New mRNA falls off the DNA template

   c. DNA will completely re-twist into a double helix

   MRNA is modifies in order to make it more stable. **Cap** – modified GTP which protects the 5' end. **Tail** – 500 A's protect mRNA from decaying.

<u>Translation</u>

mRNA is in the form of nucleotides and to make it into proteins we need amino acids.

Codon – triplet of mRNA nucleotide. Every triplet codes for one AA. 64 possibilities.

Redundancy No Ambiguity – there are many different codons that can code for the same AA, but every codon only codes for a single AA.

Start – AUG. Stop – UAA, UAG, UGA

- MRNA leaves the nucleus by the nuclear pores and enters a ribosome (either free or bound). The RNA in a ribosome is called **rRNA**.
- **TRNA** – contains an anti-codon (complementary to mRNA). It has an AA attached corresponding to the bases on the mRNA. Each codon has its own tRNA.
- **E site** = where tRNA leaves from, **P site** = codon is read, **A site** = the new tRNA enters
  - 1st tRNA enters P site
  - New tRNA always enters at the A site
  - The naked tRNA that has given away his amino acid exists at the E site

<u>Mutation</u> (change in DNA)

Mutagens cause mutations

Types of Mutation:

1. **Silent Point Mutation** – mutate a single nucleotide which does not change the AA → final protein is unchanged.
2. **Missense Point Mutation** – a single point mutation that changes AA → potentially the entire protein.