Robert Hooke

- Used a small hand held “microscope” to view small chambers within cork
- **Was reminded of prayer “cells”**
- Called these chambers “Cells”
Anton Van Leeuwenhoek

• 1675 (Reached Notoriety)
• Dutch lens maker (hobby); Grocery bagger; Night time janitor
• Recognized as the creator of CLM
THE CELL THEORY

• Theodore Schwann: (zoologist) who believed that all animals were made of cells

• Mathias Schleiden, (botanist) who believed all plants were made of cells

• Charged with DEFINING LIFE
The Original Theory

• These two scientists devised one of the best “Life” theories

• The original cell theory stated these 3 ideas:
  – 1. The cell is the unit of structure, physiology, and organization in living things
  – 2. The cell retains a dual existence as a distinct entity and a building block in the construction of organisms
  – 3. Cells form by free-cell formation, similar to the formation of crystals
1. The cell is the unit of structure, physiology, and organization in living things

• This basically means that:
  – All living things are made of cells
• Our current belief is, “If it doesn’t have cells, it isn’t classified as what we currently consider alive in the scientific community
2. The cell retains a dual existence as a distinct entity and a building block in the construction of organisms

• This basically means that:
  – Cells are the basic units of structure and function in living things
• Cells are THE MOST basic building blocks of life
  – If you get any smaller than a cell, you are no longer dealing with something that is ALIVE
3. **Cells form by free-cell formation, similar to the formation of crystals**

- This basically means that:
  - Cells (and life) form very similar to the way salt crystal form on your skin after you swim in the ocean
  - They **Spontaneously Generate** themselves
Spontaneous Generation

• Years ago, it was generally believed that life just “formed” in lower life forms
• A mouse formed from leaving cheese in a barn
• Mold formed from leaving food out in the sun
• They just appeared
• This was the current scientific belief at that time
Rudolf Virchow

• Rudolf Virchow corrected this third rule with his research on cellular reproduction
• He concluded that a cell only arises from pre-existing cells
• Cells ONLY come from other cells
• Generally, they only come from the same type of cell as well
The Last 2 Rules

• (NOT IN YOUR BOOK)
• 4. Cells contain hereditary information which is passed from cell to cell during cell division
• 5. All cells are basically the same in chemical composition
Current CELL THEORY

1. All living things are made up of cells
2. The cell is the structural & functional unit of all living things
3. All cells come from pre-existing cells by division
4. Cells contain hereditary information which is passed from cell to cell during cell division
5. All cells are basically the same in chemical composition
Scientist Method

• After his death on August 30, 1723, a member of the Royal Society wrote... "Antony van Leeuwenhoek considered that what is true in natural philosophy can be most fruitfully investigated by the experimental method, supported by the evidence of the senses; for which reason, by diligence and tireless labour he made with his own hand certain most excellent lenses, with the aid of which he discovered many secrets of Nature, now famous throughout the whole philosophical World". No truer definition of the scientific method may be found.
Advances in Technology

• Through the advances in technology made by Anton van Leeuwenhoek science was able to move through new doors
• Of course, since he advanced the science, he had first dibs on the discoveries
More Cells?

- Are the cells in our bodies the only type?
  - Animal Cells
  - Plant Cells
  - Protist Cells
  - Fungal Cells
  - Bacterial Cells
The main difference between types of cells is if they have a nucleus.
Inside the Cell

Thanks to the selective permeability of the phospholipid bilayer and the activity of membrane transport proteins, the plasma membrane creates an environment that is different from conditions outside the cell.
Diffusion

• In a solution, particles are ALWAYS moving
• Under normal pressure, particles try to spread out evenly across a solution
• As a result, particles tend to move from high concentration to lower concentration
  – This decreases collision
• This is the process of **Diffusion**
• Once the concentration is the same throughout, it is called **Equilibrium**
Facilitated Diffusion

• Water and small molecules can diffuse across the lipid bilayer in the plasma membrane, but what about large molecules like glucose???
  – These large molecules require doors in the plasma membrane called protein channels
  – By limiting the amount of these large protein channels, the cell can control how much glucose enters the cell
Active Transport Diffusion

• Both diffusion and facilitated diffusion do not require energy to move particles into and out of cells
• However, some particles do require energy to allow them to cross the cell membrane
• These particles use transport protein pumps that use cell energy (ATP) to allow items to enter the cell or leave the cell
• Often times this against a concentration gradient
  – From low concentration to high concentration
Cotransport

• A **cotransporter** is an integral membrane protein that is involved in “secondary active” transport.

• It works by binding to two molecules or ions at a time
  – using the gradient of one solute's concentration to force the other molecule or ion **against** its gradient.
  – This allows for a molecule to be moved against a concentration gradient w/o the use of ATP
Cytoplasm

• The contents inside the cell that are not the nucleus are collectively termed **Cytoplasm**
• Often times it is considered just the jelly like material surrounding the organelles, but aside from the nucleus it contains the organelles
• The fluid portion of the cytoplasm is called the **cytosol**
• It contains HIGH levels of solutes (dissolved substances) and is therefore hypertonic relative to most environments
• This causes water to enter the cell via osmosis
Osmolarity & Tonicity

• Osmosis is the movement of water from an area of high water concentration (low solute concentration) to an area of lower water concentration (higher solute concentration)

• Tonicity is relative to viewpoint

• ALWAYS consider if you are considering the cell or solution when deciding tonicity
Osmolarity & Tonicity

• 3 different tonicities:
  – **HYPERTONIC solution:** There is more dissolved substances and less water OUTSIDE the cell than inside the cell, therefore water EXITS the cell via osmosis pressure through the lipid bilayer
  – **HYPOTONIC solution:** There is more dissolved substances and less water INSIDE the cell than outside the cell, therefore water ENTERS the cell via osmosis pressure through the lipid bilayer
  – **ISOTONIC solution:** There is THE SAME AMOUNT of dissolved substances and water outside the cell as inside the cell, therefore water move equally throughout the cell and the pressure does not change
Osmolarity & Tonicity

• The reason osmosis works the way it does is that water moves through the semi-permeable membrane through very small gaps in between the lipid bilayer.

• Once in the area of high solute concentration, the water molecules stick to, bind, or are attracted to the various solute.

• Now, they are to large to fit back through the semi-permeable membrane.
Tonicity to a Cell

- The solution a cell is in and its relative tonicity to a cell is essential to the survival of a cell.
- This regulation is one of the most important aspects of the plasma and cell membrane.
Why do things diffuse?

• Remember that diffusion happens readily (on its own) in liquids and gasses

• This occurs because molecules in liquids and gasses are all moving (kinetic energy)
  – Kinetic energy = thermal energy

• The warmer something is the faster the molecules diffuse
  – The faster diffusion occurs

• As molecules diffuse across a membrane they are always trying to decrease collisions
NOT ALL CELLS ARE THE SAME

But they do have a very similar chemical makeup and mechanism.

Cells make up nearly every part of everything that is alive or ever has been alive, therefore to understand cells is to understand life.

One characteristic that distinguishes Eukaryotic cells is the use of organelles.
The NUCLEUS

• Structurally, the nucleus is composed of three main parts:
  – **The nucleolus**: which contains and forms the large and small ribosomes, RNA, DNA, and proteins
  – **The nuclear envelope**: allows the nucleus to control the rest of the cell, such as by sending out ATP. The envelope will let molecules like ATP through but will keep other things in or out, so the nucleus is isolated from the cytoplasm.
  – **The chromatin**: (meaning "colored substance") contains DNA and proteins formed into packets of code called chromosomes
    • Heterochromatin: One section of the chromatin that is highly compacted, supercoils
    • Euchromatin: Area of chromatin that is composed of long, unwound, filamentous strands
The NUCLEUS

- The largest organelle inside the cell
- Causes a cell to be **Eukaryotic** or **Prokaryotic** (Presence or absence of a nucleus)
- Minimum of one per Eukaryotic cell
- Often considered the brain or central organelle of the cell
- Major purpose is cell control and reproduction
Eukaryotic vs. Prokaryotic

• As just mentioned, if a cell has a nucleus it is considered Eukaryotic, and higher evolved
  – IE: Humans, Animals, Plants, Protists, Fungi
• If it lacks a nucleus it is considered Prokaryotic and is less evolved
  – IE: Archaebacteria, Eubacteria
Ribosomes

• Assemble Proteins
  – It translates Messenger RNA (mRNA) into a polypeptide chain (e.g., a protein). It can be thought of as a factory that builds a protein from a set of genetic instructions

• Comprised of two subunits:
  – Each subunit contains a large RNA molecule and several different proteins
    – Small subunit
    – Large subunit
      • In Eukaryotes, the large subunit also contains two small RNA molecules
        – In Prokaryotes it has only one small subunit
The Rest

• Eukaryotic organelles are every bit as important to a cell as your organs are to your body.

• Lucky for all of you, your classmates have created fantastic presentations to tell you about all of them!