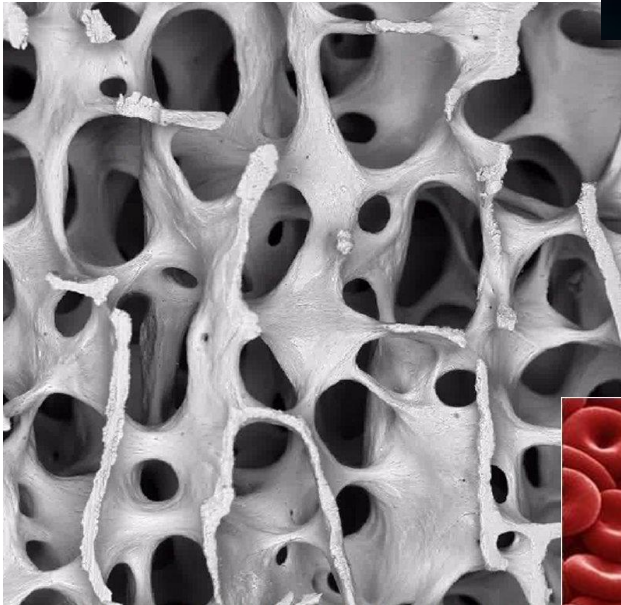


Cells are the **basic structural, functional, and biological unit** of all known living organisms.



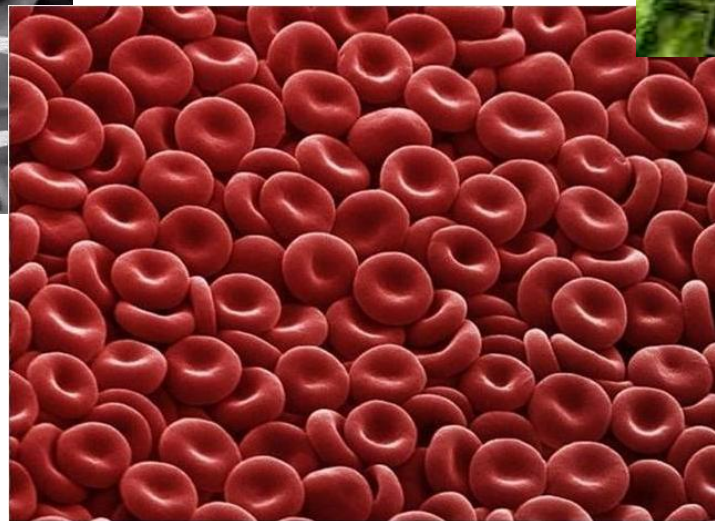
Cells are often called the **"building blocks of life"**.



Cells

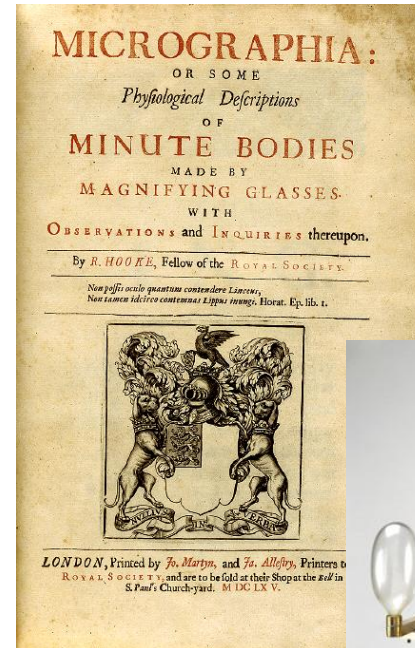
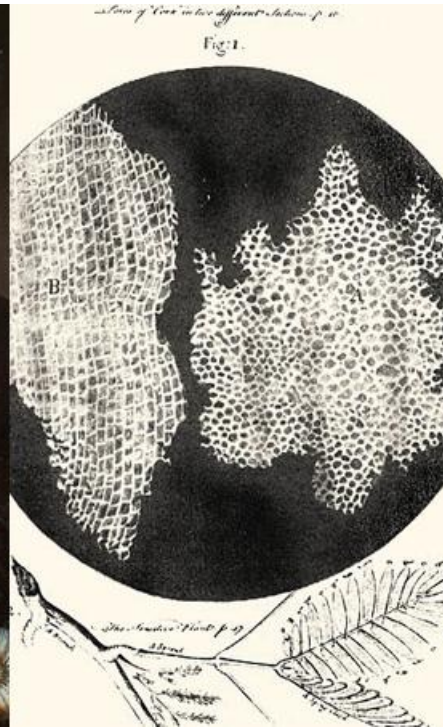


The study of cells is called **cell biology**.



Knowing the **components** of cells **and how cells work** is fundamental to all biological sciences.

Discovery of Cells



Micrographia,
published in
← 1665

**Hooke's design
microscope
system →**



Robert Hooke (1665):

- Observed a **thin slice of cork** (dead plant cells) with a **microscope**.
- Described what he observed as “little boxes” (**cells**).

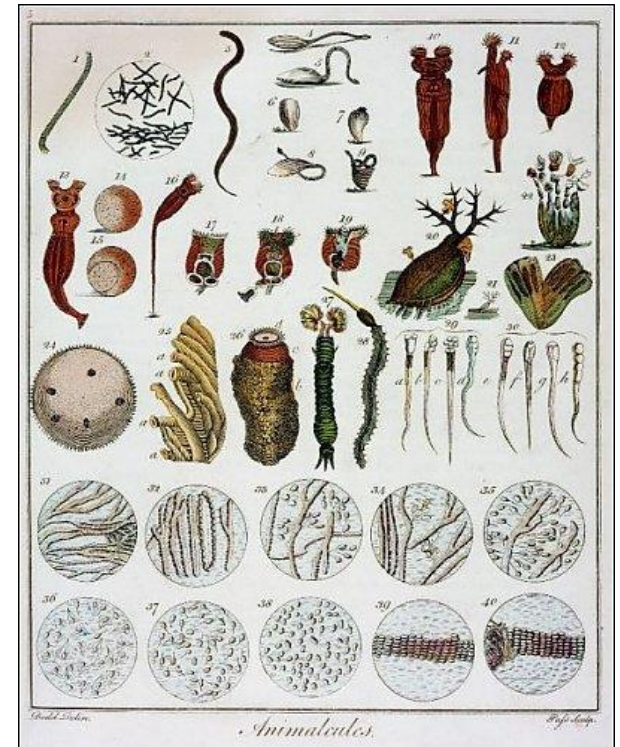
Discovery of Cells

Antonie van Leeuwenhoek (1675):

- Discovered a way to create a very small, high-quality glass spheres that became the **lenses of his tiny microscopes**, with the smallest spheres providing the highest (up to 500X) magnification.



- The first person to **observe living cells and describe single-celled organisms** (infusoria in 1674, bacteria in 1676) and the vacuole of a plant cell.
- Commonly known as "the Father of Microbiology".



Development of Cell Theory

Cell theory is a scientific theory which describes the **properties of cells** as basic units of structure and reproduction in all organisms.

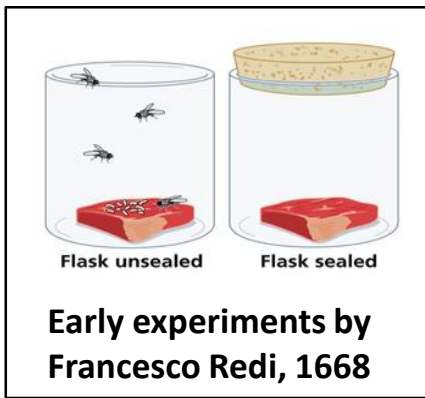


- **Matthias Schleiden** (1838): concluded that all plants are composed of cells.
- **Theodor Schwann** (1839): concluded that all animals are composed of cells.
- **Rudolph Virchow** (1855): determined that cells come only from other cells.



Cell Theory

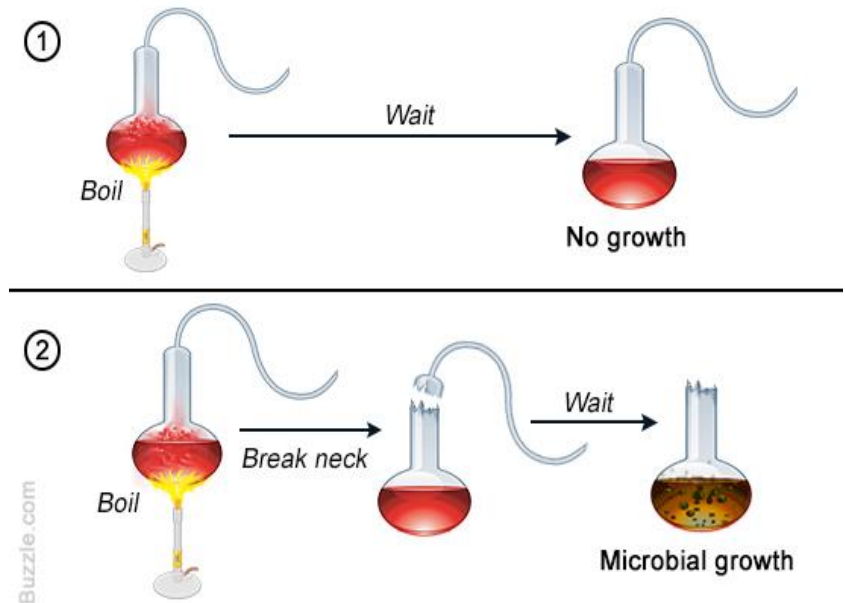
- **All living things are composed of cells** (organisms may be *unicellular* or *multicellular*).
- Cells are the basic unit of structure and function in living things.
- **Energy flow** (*metabolism* and *biochemistry*) occurs within cells.
- **Heredity information** (in the form of *DNA*) is contained inside cells and is passed on from cell to cell.
- **Cell activity** depends on the activity of sub-cellular structures.
- The activity of an organism depends on the total activity of independent cells.
- **All cells** have the **same basic chemical composition**.
- **New cells** are produced **from existing cells only**.



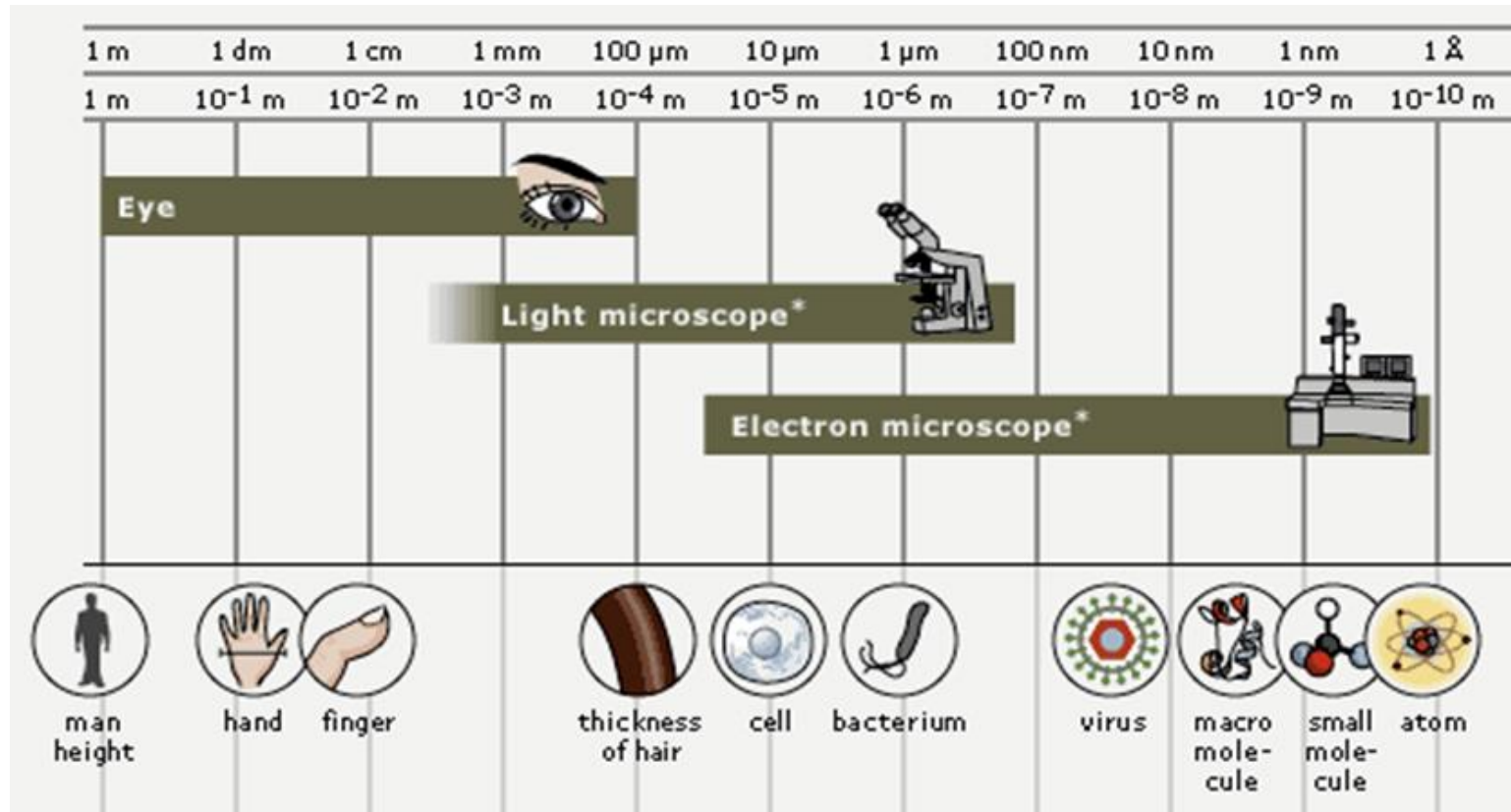
Swan-neck flasks experiment, Louis Pasteur 1864



- Demonstrated that **organisms** such as bacteria and fungi **do not spontaneously appear** in sterile, nutrient-rich media, but only **invade them from outside**.
- The theory of Spontaneous Generation (1861): *living things can originate from non-living*.
- Pasteur exposed **boiled broths** to air in vessels that had **open long s-shaped necks** that would not allow dust particles to pass to the growth medium.
- **Nothing grew** in the broths unless the flasks were broken open, thus **disproving the theory of spontaneous generation**.



Observing Cells: Microscopes

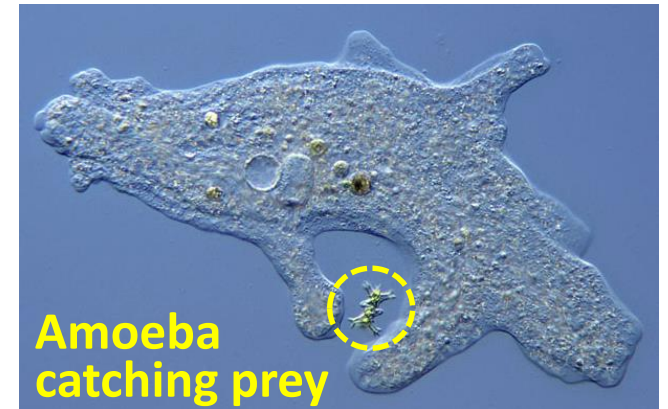
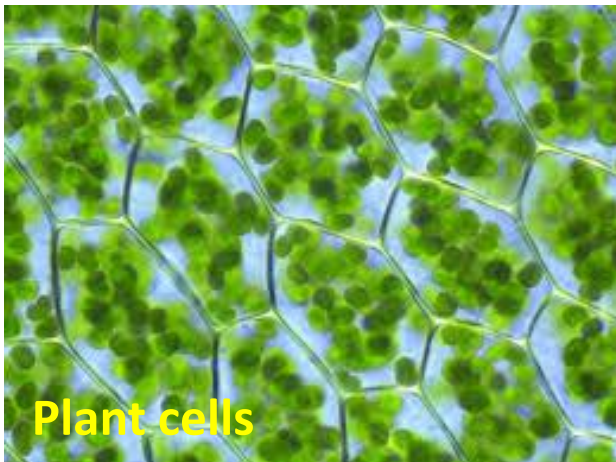


- **Magnification:** refers to the microscope's power to increase an object's apparent size.

- **Resolution:** refers to the microscope's power to show detail clearly.

Observing Cells: Light Microscope

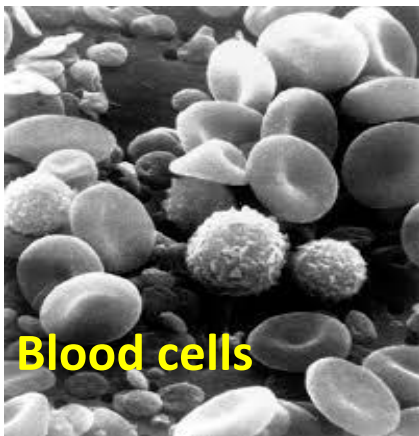
- Invented around 1590-1600, name “microscope” given in 1625.
- Uses **visible light** and a **system of lenses**.
- Magnification of up to **~2000X**.
- Resolution ~200-500 nm (limited by diffraction of visible light).
- Makes it possible to **observe living cells in true color**.



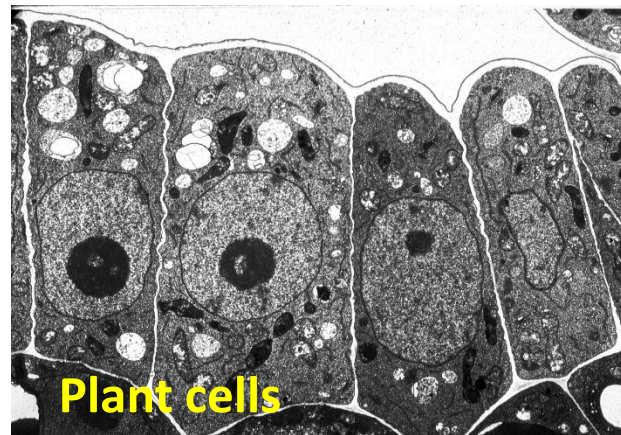
Observing Cells: Electron Microscope

- Uses **accelerated electrons** as a source of illumination together with **electrostatic and electromagnetic lenses** to control the electron beam and focus it to form an image.
- 2D or 3D black and white images (may be colorized) with magnification of up to **~10,000,000X**
- Preparation needed (for example, chemical fixation or freeze drying) **kills the cells.**

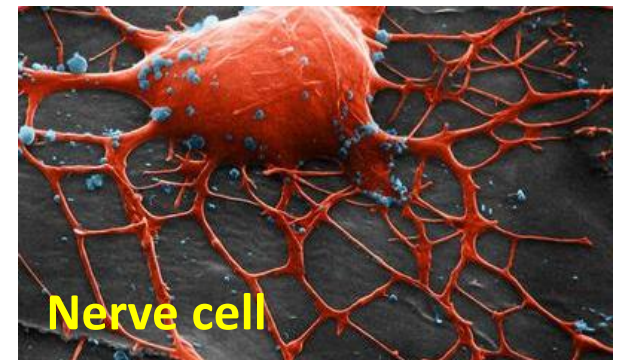
Invented
~1930; first
commercial
device
produced by
Siemens in
1939.



Blood cells



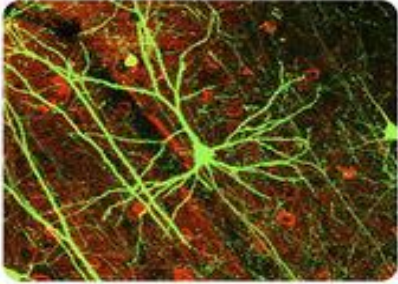
Plant cells



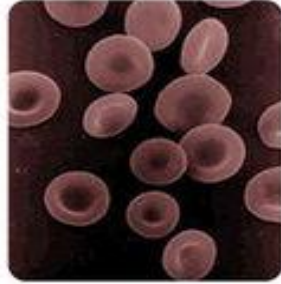
Nerve cell

Cell Diversity: Shape

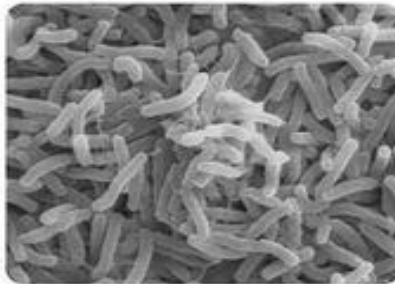
Cells differ widely (and wildly!) in shape...



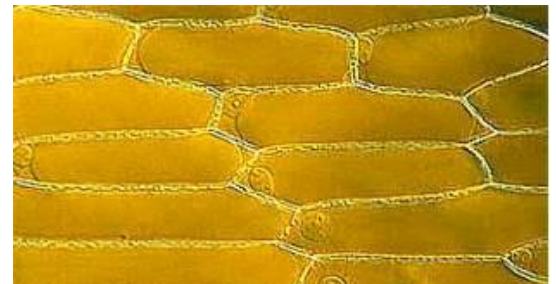
Nerve cell



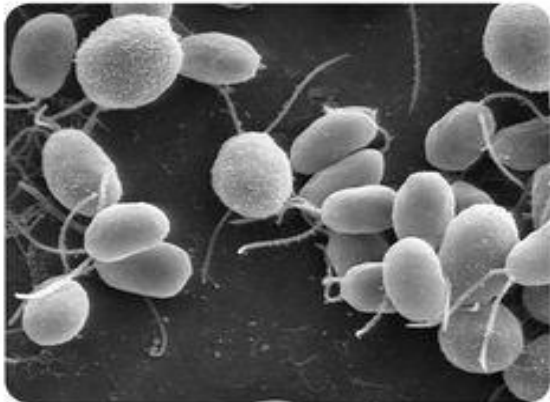
Red blood cells



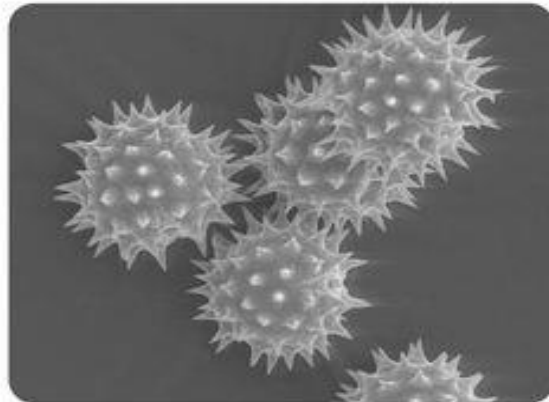
Bacteria



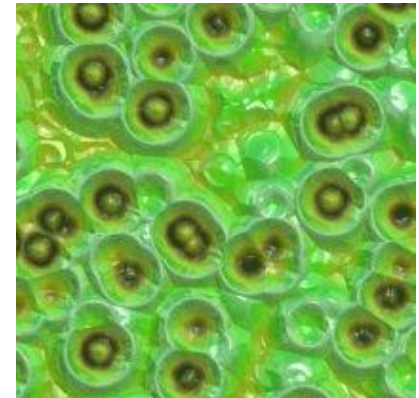
Plant cells



Algae



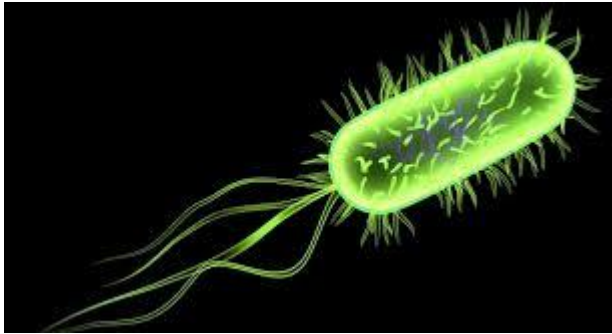
Pollen grains



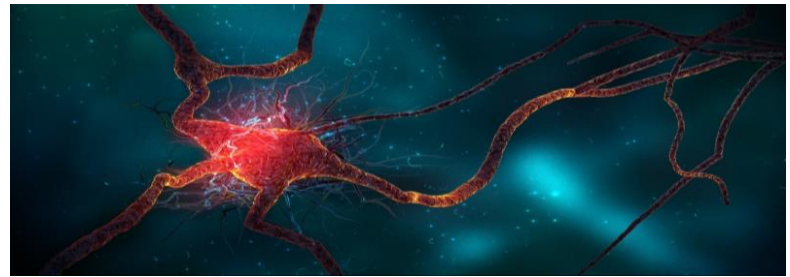
...but most cells are roughly **cuboidal** or **spherical**.

Cell Diversity: Size

Smallest: Bacterium
2-10 micrometers



Longest: Giraffe nerve cell
up to 2 meters long



Largest: aquatic alga
Caulerpa taxifolia



Heaviest: Ostrich egg
6x5 inches, 3 pounds

