GLG 101 - CHAPTER 1 - INTRODUCTION TO GEOLOGY

- All science is based on the assumption that the natural world behaves in a consistent and predictable way. Scientific inquiry is based on using the **scientific method**.
    - The **scientific method** involves making observations (collecting facts), coming up with a **hypothesis** to explain these observations, developing ways to **test** the hypothesis and performing the test(s), accepting or rejecting/modifying the hypothesis based on the test results, and eventually producing a theory that is consistent with the results of extensive testing; theories must always be open to further testing and modification.

- Geology – "the study of the Earth"
    - **Physical Geology** includes the materials, structures (shapes and arrangements of rocks, etc.) and processes that occur on the Earth's surface and in its interior.
    - **Historical Geology** seeks to understand the origin of the Earth and its development through time.

- **Catastrophism** – Earth's landscapes have been shaped primarily by infrequent, massive catastrophic events (floods, volcanic eruptions, huge earthquakes), and gradual change over long periods of time has a minor effect.

- **Uniformitarianism** – The physical, chemical and biological "laws" that operate on Earth today also operated in the geologic past, and shaped the landscapes accordingly. This is important, because it says that we can observe current processes and their resulting rocks and landforms, find similar old rocks and landforms, and make the inference that the processes observed today also happened in the past to create the older features.

- **James Hutton** advanced the idea of uniformitarianism in geology; He is sometimes considered the "**father of geology**"; he worked during the late 1700s in Scotland.

- Sir **Charles Lyell** was the first scientist to advance the fundamental principles of geology as a true science.
    - Such principles include **superposition** (the bottom layer of rock is the oldest and rocks get progressively younger upward in a stack), and **faunal succession** (fossil organisms succeed one another in a definite and determinable order, making it possible to recognize a time period by its distinctive set of fossils).
    - **Relative dating**, using these principles, involves putting rocks and structures **in order of occurrence**, independently of their exact numerical ages.

- Earth's physical environment can be divided into three parts: the **hydrosphere** (water), the **atmosphere** (gaseous layer around the outside), and the **solid (rocky) Earth**.

- The Earth's surface can be divided into **continents** and **ocean basins**.
    - The continents include **mountain ranges** (usually along the edges of continents) and the stable **shield** in the interior of the continent.
    - The ocean floors exhibit **trenches** and **ocean ridge systems**.
    - Continental mountain ranges, shields, ocean trenches and ocean ridge systems all are the result of the restless motion of chunks of the Earth's **lithosphere** through the process of **Plate Tectonics**.

- The **nebular hypothesis** describes the formation of the solar system from a contracting cloud of interstellar dust and gas that heated up and began nuclear fusion to produce the Sun, followed by coagulation of materials in a spinning disk of dust and gases around the Sun to form the planets, asteroids and comets that orbit the central Sun. Inner planets, in a hotter part of the solar system, are made of rock and metal. The outer planets and comets, in progressively cooler parts of the solar system, are made of various ices (frozen from gases like water vapor, carbon dioxide, methane, ammonia, carbon monoxide and nitrogen) in addition to rocky materials.

- The solid Earth is divided (by composition) into the **crust, upper mantle, lower mantle, outer core** and **inner core**. The core layers are mostly metallic iron, with the outer core being a liquid, whereas the crust and mantle layers are composed primarily of rocky (silicate minerals) materials.

- Mechanically, the Earth's near-surface can be divided into the brittle **lithosphere**, which is the crust and upper mantle that compose the rigid plates, and the "gooey", hot **asthenosphere** within which the rigid plates 'float' and move around over time.

- Plates can be primarily made of **continental** crust and mantle, or of **oceanic** crust and mantle.

- The theory of **Plate Tectonics** describes the motions and resulting structures of such plates of lithosphere, including three types of plate boundaries based on relative plate motions: **convergent** (moving towards each other), **divergent** (moving away from each other), and **transform** (sliding past one another).

- The majority of mountain ranges, volcanoes and intense earthquake activity occur along present or ancient **plate boundaries**.

- The Earth is a complex system of interacting parts, exemplified by the **rock cycle**. In this cycle, new **igneous** rock is created from cooling and crystallizing of **magma** beneath or on the Earth's surface. Rock can then be broken down by **weathering** processes to form **sediment** that gets **lithified** (hardened) into **sedimentary** rock and/or heated and squeezed into altered forms called **metamorphic** rocks.