Revolution of the Earth

i. What is Revolution?

Revolution is the movement of one object in a path, called an orbit, around another object. In our case, it is the Earth's journey around the Sun.

- **Think of it like this:** Imagine you are running around a large circular track. The track is the Earth's orbit, and the center of the track is the Sun. Your complete lap around the track is one revolution.

Key Details:

- **The Path (Orbit):** The Earth's orbit is not a perfect circle. It is a slightly oval-shaped path called an ellipse**.** The Sun is not at the exact center of this ellipse.
- **Direction:** The Earth revolves around the Sun in a counter-clockwise direction (as viewed from above the North Pole).
- **Speed:** The Earth travels at an incredible average speed of about 30 kilometers per second (or 107,000 km/h) through space. We don't feel this motion because everything on Earth (including the atmosphere) is moving with us.

ii. Key Points and Important Terms

- **Revolution:** The movement of the Earth in its orbit around the Sun.
- **Orbit:** The fixed, elliptical path the Earth takes around the Sun.
- **Solar Year:** The time it takes for the Earth to complete one full revolution around the Sun.
  - **Duration:** Approximately 365.25 days.
- **Leap Year:** Because our calendar year is 365 days, we have an extra 0.25 (or 1/4) of a day each year. To fix this, we add one extra day to the calendar every four years. This year is called a leap year (366 days), and the extra day is February 29th.
  - 0.25 + 0.25 + 0.25 + 0.25 = 1 full day
- **Axial Tilt:** This is the most important factor for seasons. The Earth is not straight up and down. Its axis (the imaginary line through the North and South Poles) is tilted at an angle of 23.5 degrees. This tilt always points in the same direction in space as the Earth orbits the Sun.

iii. The Main Effect of Revolution: The Seasons

The combination of the Earth's revolution and its 23.5° axial tilt causes the seasons.

How it Works:

As the Earth revolves around the Sun, the tilt of its axis determines which part of the Earth receives the most direct sunlight.

- **Direct Sunlight:** When a hemisphere is tilted towards the Sun, it receives direct, concentrated sunlight. The sun's rays hit the ground at a steep angle, delivering more energy per area. This results in warmer temperatures and SUMMER. The days are also longer.
- **Indirect Sunlight:** When a hemisphere is tilted away from the Sun, it receives indirect, spread-out sunlight. The sun's rays hit the ground at a shallow angle, and the energy is less concentrated. This results in cooler temperatures and WINTER. The days are also shorter.

Key Positions in Earth's Orbit:

- **Summer Solstice (around June 21st):**
  - The Northern Hemisphere is tilted directly towards the Sun.
  - It experiences its longest day and the official start of summer.
  - The Southern Hemisphere is tilted away, experiencing its shortest day and the start of winter.
- **Winter Solstice (around December 21st):**
  - The Northern Hemisphere is tilted directly away from the Sun.
  - It experiences its shortest day and the official start of winter.
  - The Southern Hemisphere is tilted towards the Sun, experiencing its longest day and the start of summer.
- **Equinoxes (Spring/Vernal around March 21st & Autumnal around September 22nd):**
  - On these two days, the Earth's tilt is neither towards nor away from the Sun.
  - Both hemispheres receive nearly equal amounts of sunlight.
  - Day and night are approximately equal in length all over the world (Equinox means "equal night").
  - March: Start of Spring in the Northern Hemisphere, Autumn in the Southern.

- September: Start of Autumn in the Northern Hemisphere, Spring in the Southern.

iv. Common Misconceptions and Clarifications

Misconception	Clarification
"Seasons are caused by the Earth being closer or farther from the Sun".	FALSE. The Earth's orbit is elliptical, but the distance change is small and not the cause of seasons. In fact, the Earth is slightly closer to the Sun in January (Northern Hemisphere's winter). The real cause is the 23.5° axial tilt.
"The whole world has summer at the same time".	FALSE. The seasons are opposite in the Northern and Southern Hemispheres. When it is summer in the USA (Northern), it is winter in Australia (Southern).
"Rotation and Revolution are the same thing".	FALSE. Rotation is the Earth spinning on its axis (1 day), which causes day and night. Revolution is the Earth orbiting the Sun (1 year), which causes the year and the seasons (with the tilt).

v. Practice Problems with Solutions

Problem 1: If the Earth's axis was not tilted (an axial tilt of 0 degrees), what would happen to the seasons? Explain your answer.

- **Step 1:** Recall the cause of seasons. The seasons are caused by the Earth's 23.5° axial tilt combined with its revolution.
- **Step 2:** Remove the tilt. If the tilt were 0 degrees, the Earth would be sitting straight up and down relative to its orbit.
- **Step 3:** Determine the effect. As the Earth revolved around the Sun, the sunlight would always strike the Earth in the same way. The Equator would always receive the most direct light, and the poles would always receive the least direct light.
- **Solution:** There would be no seasons. The climate in any given location would stay the same all year round. The Equator would be permanently hot, and the poles would be permanently cold, with mild temperatures in between.

Problem 2: It is July in Brazil, which is in the Southern Hemisphere. What season is it? What season is it in Japan, which is in the Northern Hemisphere? Why?

- **Step 1:** Identify the month and hemisphere. The month is July, and the location is Brazil (Southern Hemisphere).

- **Step 2:** Relate the month to the Earth's position. July is just after the June Solstice. During the June Solstice, the Northern Hemisphere is tilted towards the Sun (Summer), and the Southern Hemisphere is tilted away.
- **Step 3:** Determine the season in Brazil. Since the Southern Hemisphere is tilted away from the Sun in July, it is Winter in Brazil.
- **Step 4:** Determine the season in Japan. Japan is in the Northern Hemisphere. Since the Northern Hemisphere is tilted towards the Sun in July, it is Summer in Japan.
- **Solution:** It is Winter in Brazil and Summer in Japan. This is because the seasons are opposite in the Northern and Southern Hemispheres due to the Earth's tilt.

vi. Summary of Main Concepts

- Revolution is the Earth's 1-year journey around the Sun in an elliptical orbit.
- One revolution takes 365.25 days, which leads to the creation of a leap year every four years.
- The main consequence of revolution, when combined with the Earth's 23.5° axial tilt, is the cycle of seasons.
- When a hemisphere is tilted towards the Sun, it gets direct sunlight and experiences summer.
- When a hemisphere is tilted away from the Sun, it gets indirect sunlight and experiences winter.
- Equinoxes are when both hemispheres get nearly equal sunlight (start of Spring and Autumn).
- Solstices are when one hemisphere gets the most sunlight and the other gets the least (start of summer and winter).