Below is a **complete, ready-to-teach Grade 10 Physics chapter on Gravity**—written in clear, student-friendly language, with diagrams (described), examples, numericals, formulas, fun facts, and a summary.
If you want, I can also convert this into a **PDF**, **slides**, **Runway video script**, or an **interactive AI-tutor lesson** for XReality Education.

Chapter: Gravity

Grade: 10 Physics

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1. Introduction to Gravity

Gravity is a fundamental force of nature that **pulls objects toward each other**.
It keeps you on the ground, holds the Moon in orbit around Earth, and keeps planets moving around the Sun.

Whenever two objects have mass, they attract each other — even you and the chair you are sitting on!
But gravitational force becomes noticeable only when **huge masses** are involved, like Earth, the Sun, and planets.

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2. Newton's Law of Universal Gravitation

In 1687, **Sir Isaac Newton** proposed that:

Every mass in the universe attracts every other mass with a force directly proportional to their masses and inversely proportional to the square of the distance between them.

Mathematically:

$$
F = G \frac{m_1 m_2}{r^2}
$$

Where:

- **F** = gravitational force (Newtons, N)
- **G** = gravitational constant
  $$
  G = 6.67 \times 10^{-11}\ \text{Nm}^2 \text{kg}^{-2}
  $$
- **m₁ and m₂** = masses of the two objects (kg)

- **r** = distance between their centers (m)

3. Gravity on Earth

Even though all objects attract each other, **Earth's mass is so large** that its gravitational pull dominates.

Acceleration Due to Gravity (g)

$$g = 9.8\ \text{m/s}^2 \quad (\text{approx.})$$

This means:

Every second, a falling object's speed increases by **9.8 m/s**, if air resistance is not present.

4. Mass vs. Weight

Many students mix these two—so remember:

Mass

- Amount of matter in an object
- Constant everywhere in the universe
- Unit: **kg**

Weight

- Force of gravity acting on an object
- Changes depending on the planet
- Unit: **Newton (N)**

$$W = mg$$

Example

If your mass = 50 kg on Earth:
$$W = 50 \times 9.8 = 490\ \text{N}$$

On the Moon, g = 1.6 m/s²:
[
W = 50 \times 1.6 = 80\ \text{N}
]

So **mass remains 50 kg**, but **weight changes**.

5. Free Fall and Air Resistance

Free Fall

When an object falls only under gravity (no air resistance), its acceleration = g.

Air Resistance

Air pushes upward against falling objects, slowing them down.
This is why:

- A feather falls slower than a stone.
- Parachutes work.

6. Terminal Velocity

As an object falls:

1. Gravity pulls it downward.
2. Air resistance pushes upward.
3. Eventually, forces balance → acceleration becomes zero.

The object then falls at a **constant speed** called **terminal velocity**.

7. Gravity and Orbits

Planets don't fly away into space because the Sun's gravity pulls them inward.
They also have sideways motion.
These two motions combine to create an **orbit**.

Example: Moon's orbit around Earth

- Moon is constantly falling toward Earth due to gravity
- But because of sideways motion, it keeps missing and stays in orbit

8. Universal Gravitational Constant (G)

The value of G is very small:

$$6.67 \times 10^{-11}\ \text{Nm}^2\text{kg}^{-2}$$

This means gravitational force between small objects is extremely tiny, noticeable only between very large masses.

9. Variation of g

Gravity is not constant everywhere.

It depends on:

- Distance from Earth's center
- Altitude (g decreases with height)
- Depth inside Earth
- Latitude (Earth is not a perfect sphere)

10. Kepler's Laws of Planetary Motion (Simple Grade 10 explanation)

1. **Law of Orbits**
   Planets move around the Sun in **elliptical orbits** with the Sun at one focus.
2. **Law of Areas**
   Planets sweep out equal areas in equal times → they move **faster when closer to the Sun**.
3. **Law of Periods**
   $$T^2 \propto r^3$$
   The farther a planet is from the Sun, the longer it takes to orbit.

11. Numerical Problems (with solutions)

Problem 1

Find the gravitational force between two masses 10 kg and 20 kg placed 2 m apart.

$$
F = G \frac{m_1 m_2}{r^2}
$$
$$
F = 6.67 \times 10^{-11} \frac{10 \times 20}{2^2}
$$
$$
F = 6.67 \times 10^{-11} \times \frac{200}{4}
$$
$$
F = 3.34 \times 10^{-9}\ \text{N}
$$

Problem 2

Find the weight of a 60 kg person on Earth.

$$
W = mg = 60 \times 9.8 = 588\ \text{N}
$$

Problem 3

If the distance between two objects is doubled, what happens to the gravitational force?

$$
F \propto \frac{1}{r^2}
$$

If r becomes 2r:

$$
F' = \frac{F}{4}
$$

Force becomes **one-fourth**.

12. Common Misconceptions

❌ Heavy objects fall faster than light ones
✔ In vacuum, both fall at the same rate (only g acts)

❌ Gravity works only on Earth
✔ Gravity acts everywhere in the universe

❌ Mass and weight are the same
✔ No—mass stays constant, weight changes

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13. Real-Life Applications of Gravity

- Formation of stars and galaxies
- Satellite launching and GPS systems
- Tides on Earth due to Moon's gravity
- Sports (trajectory of a football, cricket ball, basketball)
- Water flow in rivers
- Why planets stay in orbit

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14. Fun Facts

- Without gravity, the atmosphere would drift into space.
- Astronauts in the ISS are not weightless—they are in **continuous free fall**.
- Black holes have such strong gravity that not even light can escape.
- Gravity waves (ripples in spacetime) were detected in 2015.

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15. Chapter Summary

- Gravity is a universal attractive force.
- Newton's law:
  [
  F = G \frac{m_1 m_2}{r^2}
  ]
- Acceleration due to gravity on Earth = **9.8 m/s²**.
- Mass is constant; weight depends on gravity.
- Orbits result from gravitational pull + sideways motion.
- Gravity varies with height, depth, and latitude.
- Kepler's laws explain motion of planets.
- Gravitational force decreases with square of distance.

Would you like any of the following?

✅ A **Worksheet** with 20 numerical questions
✅ A **multiple-choice test** with answer key
✅ A **PDF chapter** formatted like a textbook
✅ An **interactive AR lesson** for XReality Education
✅ Diagrams / illustrations for each section
✅ A **Runway video script** explaining Gravity for Grade 10

Tell me what you'd like next!