In Newton's era, the idea of gravity was that a force was exerted from one mass to another. However, Einstein was intrigued that the force of gravity traveled instantly across empty space, propagating at the speed of light, and its implications for the speed limit of the force of gravity. The second related to the equivalence principle, which states that the laws of physics are the same for all observers in a gravitational field.

With this principle in hand, Einstein turned his attention to Newton's theory of gravity. He concluded that the force of gravity could not be a conclusive explanation for the falling of objects on Earth.

In Einstein's General Theory of Relativity (1916), space is transformed from the Newtonian idea of a vast emptiness with nothing but the force of gravity to rule the motion of matter through the universe, to an invisible fabric of spacetime that "grips" matter and directs its course. In Einstein's search for a solution to this contradiction, his greatest breakthrough was the idea that this rate was the speed limit for all energy and forces in the universe. No "information" could travel faster than the speed of light, and its implications for the speed limit of the force of gravity. The second related to the equivalence principle, which states that the laws of physics are the same for all observers in a gravitational field.

**The Equivalence Principle**

In Einstein's search for a solution to the contradiction, his greatest break-through came when he realized that the Equivalence Principle enabled him to express his conviction that the concept of a gravitational field was an illusion. He concluded that the force of gravity is not so impotent; it is the curvature of spacetime itself that keeps us on the ground.

In Einstein's search for a solution to this contradiction, his greatest break-through came when he realized that the Equivalence Principle enabled him to express his conviction that the concept of a gravitational field was an illusion. He concluded that the force of gravity is not so impotent; it is the curvature of spacetime itself that keeps us on the ground.

**Do All Masses Fall at the Same Rate?**

- **IN SPACE**
  - **A: Dropping Balls**
    - 1. Collect several pairs of objects that are about the same size but different weights. For example, a regular golf ball and a ping pong ball.
    - 2. Before you drop it, imagine you are floating in a spaceship in outer space, far from any gravitational fields. A: Make a pencil-sized hole in the side of a plastic soda bottle, carefully using a pushpin and an exacto knife.
    - 3. Slowly swing both cups up into the starting position.
    - 4. Uncover the hole and observe what happens to the water.
    - 5. Release the bottle and let it fall to the ground. Observe what happened to the water.
    - 6. Now, do two things at the same time.
    - 7. Observe which cup reaches the bottom of the arc first.
  - **B: Swinging Pendulums**
    - 1. Stand on a stepladder or stable, sturdy chair again, as in Demonstration A.
    - 2. Take just one ball this time.
    - 3. Slowly swing both cups up into the starting position.
    - 4. Cover the hole and observe what happens to the water.
    - 5. Record your observations.
  - **C: Dragging Shadows**
    - 1. Make a pencil-sized hole in the side of a plastic soda bottle, carefully using a pushpin and an exacto knife.
    - 2. Slowly swing both cups up into the starting position.
    - 3. Uncover the hole and observe what happens to the water.
    - 4. Observe which cup reaches the bottom of the arc first.
  - **D: Accelerating Spaceship**
    - 1. Collect several pairs of objects that are about the same size but different weights. For example, a regular golf ball and a ping pong ball.
    - 2. Before you drop it, imagine you are floating in a spaceship in outer space, far from any gravitational fields.
    - 3. Slowly swing both cups up into the starting position.
    - 4. Uncover the hole and observe what happens to the water.
    - 5. Release the bottle and let it fall to the ground. Observe what happened to the water.
    - 6. Now, do two things at the same time.
    - 7. Observe which cup reaches the bottom of the arc first.

**Summary**

- **IN SPACE**
  - **A: Dropping Balls**
    - 1. Collect several pairs of objects that are about the same size but different weights. For example, a regular golf ball and a ping pong ball.
    - 2. Before you drop it, imagine you are floating in a spaceship in outer space, far from any gravitational fields.
    - 3. Slowly swing both cups up into the starting position.
    - 4. Uncover the hole and observe what happens to the water.
    - 5. Release the bottle and let it fall to the ground. Observe what happened to the water.
    - 6. Now, do two things at the same time.
    - 7. Observe which cup reaches the bottom of the arc first.
  - **B: Swinging Pendulums**
    - 1. Stand on a stepladder or stable, sturdy chair again, as in Demonstration A.
    - 2. Take just one ball this time.
    - 3. Slowly swing both cups up into the starting position.
    - 4. Cover the hole and observe what happens to the water.
    - 5. Record your observations.