

The Pendulum



- **Major Players:**

- **Galileo** (father of _____) 1564 – 1642 Died on Christmas day. Studied motion in U. of Pisa (dropped objects from leaning tower), telescope in U. of Padua (saw mountains on moon, moons of Jupiter, sun spots). House arrested for publishing disagreement with Church (telescope observations, Copernican Earth centered view, disagreements with Aristotle). Went blind at 74. [experiments: 1) objects accelerate from gravity 2) heavier and lighter objects fall the same if friction is ignored, 3) a pendulum keeps time]

- Leon Foucault - made the Foucault Pendulum as the first physics demonstration that the earth rotates. It was 1851. We knew the earth rotates, but this showed it easily. He took a 28 kg brass-coated lead bob with a 67 m long wire. He hung it from the ceiling of the Pantheon in Paris. It was made with so little friction that it swung quite freely. It looked like it was rotating, but the truth wa that the earth was rotating under it.

- **Christiaan Huygens** - in 1656 invented a very accurate pendulum clock that only lost 15 seconds in a day (previous *verge escapement* wheel clocks lost 15 minutes per day).

- **Lionel Robert Wilberforce** - around 1896 made the Wilburforce Pendulum. He took a mass hung from a spring. It takes turns bobbing up and down, then rotating.

- **Little Pendulum**

- Initial observations? ...

- Now, what do you think about the length of the string? _____

- **Sand Pendulum**

- Initial observations? ...

- Why are there spaces between the curves? ... _____

- Observations about the time for a full swing? ... _____

- Do you think the weight of the bob matters? _____ How to test?

- Do you think the length of the string matters? _____ How to test?

- Do you think the amplitude (length) of the swing matters? _____
How to test? _____

- **Clocks**

- What is the absolutely necessary function of a clock? _____

- Could a Pendulum be a clock? _____

- What is a quartz crystal clock? _____

- **2 Person Team Exercises**

- **Period** = time for a full swing
- Each team: test effects of weight and length of swing on the Period. (Hint: time 5 or 10 swings, then divide.)

- **The Law of the Pendulum**

- Measure the Period for 3 pendula that are in a ratio of lengths: 1 to 4 to 9.
- What Period would you predict for pendula of ratio lengths: 16 and 25?

_____, _____ **times longer**

- How could we express this pattern mathematically? _____

- **Compound Pendula**

- Wilburforce Pendulum
- Two Bob Pendulum

- **FRICITION**

- Why did the sand pendulum leave spaces between smaller and smaller curves?

- Did the length of the swing for any of the pendula stay the same?

- Can you trust FRICTION? Can you trust it enough to not move if a bowling ball pendulum is coming at your face?

- *O/A* - If there is time, create an Observation / Analysis sheet of one of the pendula.

- **Scientific Recording of Pendula: (time 5 swings, then divide by 5).**

Pendulum length 1	Pendulum length 4	Pendulum length 9	Pendulum length 16	Pendulum length 25