T is for Time Pendulums
5th grade

Common Core Standards Addressed:

W.5.2 Write informative/explanatory texts to examine a topic and convey ideas and information clearly.

W.5.8 Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources.

Arkansas K-12 Science Standards Addressed:

5-PS2-1 Support an argument that the gravitational force exerted by Earth on objects in directed down.

3-5-ETS1-3 Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.

Learning Goals:
Students will…

Understand that experiments can be conducted to solve real world problems.	
Know Pendulum: a weight hung from a fixed point that can swing freely back and forth Pendulum period: the time it takes for the pendulum complete one cycle (a left swing and a right swing) Examples of pendulums in everyday life What factors affect the period of a pendulum?	**Do** Explore how changes in the length of string or weight of pendulum impact the swing.

Materials Needed:

- *T is for Time* by Marie Smith
- Washers or weights
- String
- Timer
- Meter or yard stick
- Paper and pencils

Procedures:

- Read *T is for Time* by Marie Smith.
- There are a lot of different ways to measure time that we see in the book, such as the sundial, measuring the position of the stars, and the hourglass. Today we're going to be experimenting with one way to measure time: pendulums.
- Pendulums occur frequently in everyday life. Ask students if they can think of any examples (clocks, swings, cranes, metronomes, amusement park rides).
- Explain that no matter how high a pendulum swings, it takes the same amount of time for it to swing from one side to another. This makes it an excellent tool for measuring time.

- Students will then conduct an experiment to find an answer to this question: An old grandfather clock is running slowly. How can we adjust the pendulum to fix the clock?
    - Students will test the following variables to solve the question: string length and bob weight. Students can test additional variables (such as string material, initial force etc.) if they wish.
- Explain to students that they should start the pendulum from the same spot each time. They may want to use the yard stick and measure so that the starting point always remains at the same height.
- Have students tie a washer to the end of the string and measure the length of the string.
    - Students should record this length in their science notebooks.
- Demonstrate to the students how to count a full swing, called the "period" of a pendulum.
    - Students should then drop the pendulum and record how many swings occur in 30 seconds (one student will use the timer while the others count the swings).
    - They should record how many swings occurred on their paper.
- Students should then repeat this process by changing the length of the string (shorter and longer), and should then record how many periods occurred.
- Students should repeat this process, but this time by changing the weight of the bob (both heavier and lighter weights).
- If there is additional time, students can test other variables to see if they affect the period of a pendulum.
- Discuss with students the result of their experiments. What variables increased the amount of periods? What decreased them? Did anything surprise you? Students should find that a shorter string has more periods, while a longer string has fewer. They should also have found that the weight did not affect the number of periods.
    - A common misconception is that the period of a pendulum is determined by the weight of the pendulum bob.
- Discuss with students the initial question: An old grandfather clock is running slowly. How can we adjust the pendulum to fix the clock?
    - If the clock is running slowly, we can make the pendulum string shorter to correct the time.

Learn about Marie Smith at http://www.bentonvillelibrary.org/assets/YLF/pdfs/mariesmith-bio.pdf.