

Learning Intentions

- To learn how gravity causes objects to accelerate downwards
- To learn how to use Excel to create a graph with a best-fit line

Procedure - Data Collection

1. Work in pairs. Find another pair, and join together to form a group of 4 for data collection.
2. One person will dangle a meter-stick in the air. They should be gripping the meter stick lightly by the top end.
3. Another person records the meter stick with a camera. Be as stable as possible, and avoid shaking the camera.
4. The participant puts their hand around the meter stick, with the top of their thumb about one quarter of the distance from the bottom end.
5. After a random amount of time, the first person drops the meter stick. The participant must catch the meter stick as quickly as possible by closing their hand around the stick.
6. Repeat this procedure using a participant from the other pair.

Procedure – Physics Tracker

1. Watch the YouTube video titled “Tracker Tutorial” by MathWithoutBorders. The URL is <https://www.youtube.com/watch?v=JhI-gIsE6o>. You may want to watch at 1.5 speed, as the video is almost 18 minutes long.
2. Import your video into Physics Tracker.
3. Use the black triangles under the progress slider to trim the video. The first triangle should be a few frames before the meter stick is dropped, and the second triangle should be a few frames after the meter stick is caught.
4. Track the y position of the ruler as it drops. Be sure to use a step size of 1, so that every frame between the black triangles has the position of the ruler marked.
5. In the data table, show the time and y position columns.

Procedure – Analysis in Excel

1. Copy the data table from Physics Tracker into Excel.
2. Create a new column and calculate the average velocity of the meter stick for each frame.
3. Create another new column and calculate the average acceleration of the meter stick for each frame.

Questions

1. Create a graph, with a trendline, of the displacement of the meter stick versus time.
2. Create a graph, with a trendline, of the velocity of the meter stick versus time.
3. Create a graph, with a trendline, of the acceleration of the meter stick versus time.
4. The acceleration due to gravity is 9.81 m/s^2 [down], or -9.81 m/s^2 [up]. How close to this value is the acceleration that you calculated?
5. What could be sources of error in your acceleration calculation?
6. It is possible to use a meter stick as a reaction time tester. If the meter stick falls d meters before being caught, what is the participant's reaction time in seconds?

Assessment

	Emerging	Developing	Proficient	Extending
Content				
Kinematics (displacement, velocity, acceleration, time)				
Curricular Competencies				
Processing and analyzing data and information				
Evaluating				
Applying and innovating				