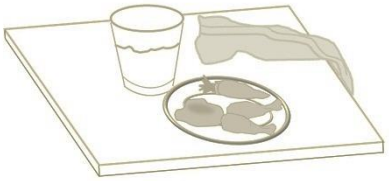
Old School Demonstrations:



Tablecloth vs. Inertia

➢ Lesson Plan: Inertia (impulse) & Newton's 1st Law of Motion

Background:

Inertia is a tendency of an object to resist a change in motion. Simply stated… an object that is at rest wants to stay at rest and an object that is moving at a constant velocity wants to continue moving at that velocity. Newton's 1st Law of Motion and inertia are often referred to as the same thing; Newton's 1st Law of Motion is sometimes called the Law of Inertia.

Although, there is a slight difference; inertia is simply a tendency of an object to resist change. Newton's 1st Law of Motion states that an object at rest (velocity = 0) or an object moving at constant velocity will remain at that velocity unless an outside unbalanced net force acts on it.

There are many examples where we see inertia (1st Law of Motion) in the everyday world. A student experiences inertia when he/she is riding a bike and forcefully applies the front brake. The bike stops, but the rider does not. The rider continues forward, flying over the handlebars. The same is true when a student is standing on a merry-go-round and another student starts to turn it. The student on the merry-go-round has a tendency of falling in the direction of the original position in space.

It is also true that the larger the object (the more mass it has), the greater the inertia. Simple stated… it is more difficult to change the motion of a larger more massive object then a smaller object. Comparing the stopping distances of a bike, a car and a train is a good example. A bike traveling at 5 $^{miles}/_{hour}$ will require less force to stop than a car or a train traveling at the same rate. I always shared the following example with my students because it is a funny/embarrassing example of science in the everyday world. The parking lot of the Bomgaars in Yankton, SD is steep. I had a bad habit of riding the cart from the exit of the store to my vehicle, against my wife's better judgment. Normally I could easily stop the cart as I approached my pickup. During one visit and my last ride; I had an abnormal amount of mass in my cart. I jumped off the cart and tried to stop it, unfortunately there was too much inertia caused by the large mass. The pickup took the brunt of my inertia lesson.

Note:

There is some discrepancy in different resources on how well the tablecloth demonstration represents inertia. As stated above, mass plays a huge role in the understanding of inertia. The items used in the demonstration have different masses (although they are relatively the same if compared to the bike/car example above), but they all seem to behave the same. The more massive glass of water appeared to behave the same as the plate and bowl. For this reason, it could be considered more of an "impulse" demonstration. The force is applied so quickly over a short amount of time that the cloth (frictional force) does not have enough time to apply the force to the table setting. The quick demonstration shown in the video lesson involving the empty CD cases may be helpful to reinforce that an increase in mass results in an increase in inertia. This is especially helpful if you decide not to change the mass of the items in the tablecloth demonstration.

Personally, I used the tablecloth demonstration to represent inertia when I taught. I explained that the force needed to be applied very quickly for it to work. Also, I had a positive experience when I reduced the amount of mass (clay and water), resulting in a more challenging demonstration - explained in the lab below.

This is a great demonstration whether you present it as "inertia" or "impulse" or explain it as a little of both. Your students will not forget it.

Tablecloth vs. Inertia

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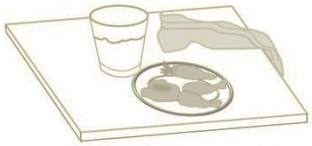


Materials:

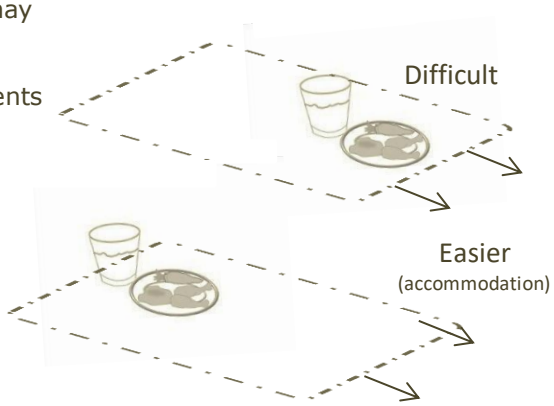
- Sheet (cut)
- Plastic kitchenware (plate, bowl, glass, clay and food)
- Safety glasses
- Water
- Towels

Procedure:

The Tablecloth vs. Inertia resource can be presented as a class demonstration or a class activity depending on the amount of time available.

- **Class Demonstration:** For a class demonstration I would select 2-3 students to complete the activity in front of the class (track student involvement so all the students participate in demonstrations throughout the year.) The more anticipation and hype leading up to the demonstration the better. This can be accomplished by having towels available, showing a cracked/broken plastic glass, indicating that it was broken during a previous year. The key to this demonstration is to pull the cloth as quickly and forcefully as you can. Hesitation or lifting up, then down usually results in devastation. I always found it easiest to pull the cloth straight down toward the floor. A long table cloth may require pulling down and back.

  The demonstration can be made easier for younger students or physically challenged students by moving the table setting closer to the end of the cloth opposite the edge you are applying the force. I have completed this demo with 3-year-old children at science fairs. This was accomplished by moving the items so half of the table setting was on the tablecloth and the other half was on the table. They did not leave the event completely understanding inertia, but I could tell by their **astonishment that they loved science.**



- **Class Activity:** This demonstration can be easily modified into an exciting classroom activity or it would be perfect for an afterschool group or summer camp. The activity would also work well to complete the day before Christmas or Thanksgiving break. I had a homeroom for a few years when I taught. Many times, we would have a half day of school before a large break. The schedule was adjusted to include homeroom activities, which usually consisted of watching movies. I started Science Olympics which included this activity; the students had fun and were engaged in science at the same time.

  Each student should complete the task with the same amount of clay/water (mass). The tablecloth and table setting should be placed in the same location for each student. Then mass can be removed, and the tablecloth can be extended so the task becomes harder and the students are eliminated. Continue to remove mass and extend the pull distance until one student remains. This activity is guaranteed to be a hit.

Related Web Resource:

- PBS LearningMedia (More lessons and video from SDPB)
- 108 Stitches the Physics of Baseball
  Lesson: https://www.pbswesternreserve.org/education/108-stitches-the-physics-in-baseball/ (Click)