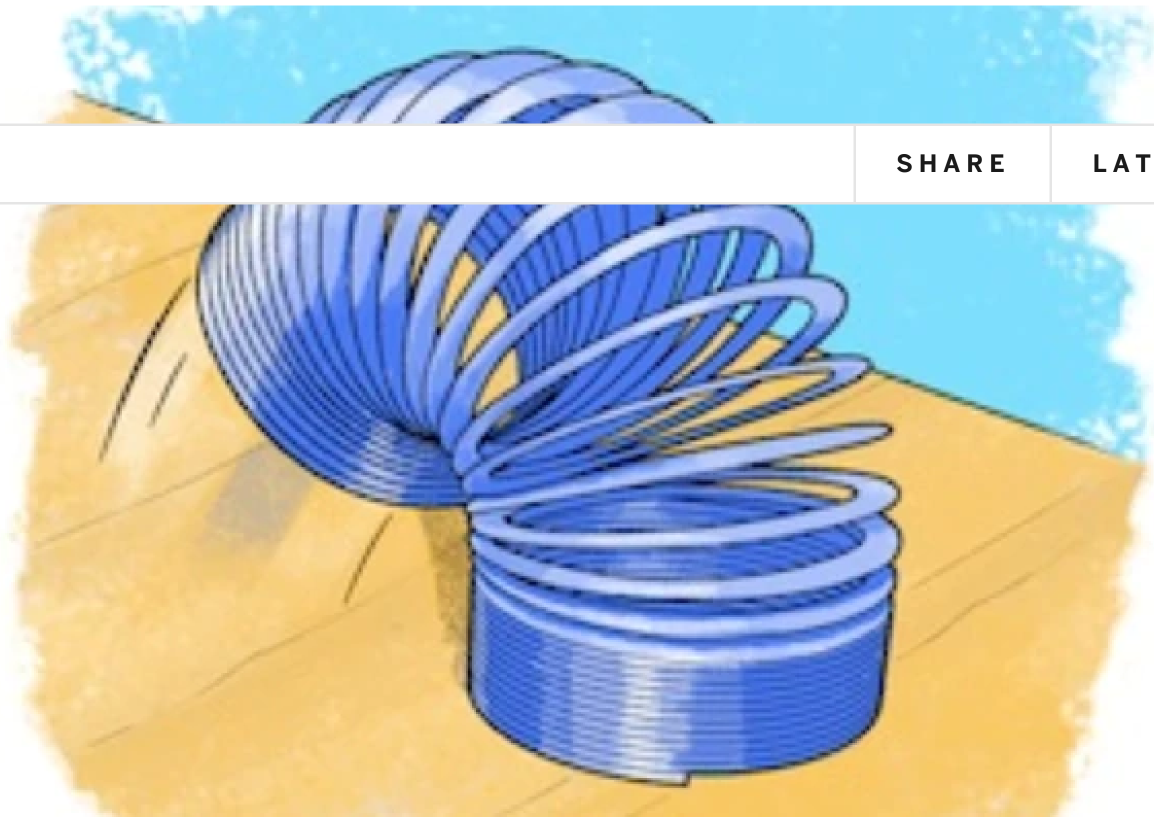
Bring Science Home

Slinking Science: Take a Slinky Toy for a Walk

An angular activity from Science Buddies

By Science Buddies on December 6, 2012



Credit: George Retseck

Key concepts
Physics
Engineering
Inclined plane
Gravity
Momentum

Introduction
Have you ever watched a Slinky "walk" down a flight of stairs and wondered how it works? It's a fascinating thing to see and a big part of the Slinky's appeal. These spring toys have been popular for well over half a century; your parents, or even

grandparents, may have played with them. Slinkies not only make fun toys, they are also great for doing physics and engineering activities. In this activity you will

Background
The Slinky is a classic toy in the U.S. and an interesting tool for physics investigations. It was not originally created, however, with either of these purposes in mind. The inventor of the Slinky was a retired Navy engineer named Richard James, who worked in the Philadelphia Naval Shipyard. He initially thought the bouncy springs would be useful on ships for supporting sensitive instruments and keeping them stable during storms at sea. But after the Navy showed no interest in his springs, his wife, Betty, had a better idea—she thought up a catchy name and Slinky the toy was born in 1945.

So how does the Slinky "walk" down a flight of stairs? To do this, the Slinky slowly flips end over end. If you watch closely, you'll see it stretches to reach the next step down, reforms itself, then stretches again to reach the next step, and so on. This process is possible because of gravity and the Slinky's own momentum. In this way a Slinky can walk down other surfaces, too, such as an inclined plane, which is a type of sloping surface that you will use in this activity.

Materials
- A sheet of plywood. Try to find one that's about two feet long by one foot wide, at least.
- Stack of books
- Protractor
- Stopwatch
- Metal Slinky (full size, not a Slinky, Jr.)
- A piece of paper and a pen or pencil
- A helper
- Other sizes and types of Slinkies (optional)

Preparation
- To make your adjustable inclined plane, rest one of the narrow ends of your piece of plywood on a stack of books and the opposite end on the floor.

- Make sure that you have enough books of varying thicknesses to create a 25-degree angle with the inclined plane. This is the largest angle you will be testing.

Procedure

- Adjust the inclined plane so that it is at a 15-degree angle. Use the protractor to confirm the angle formed where the base of the plane meets the floor.
- Have a helper get ready with a stopwatch.
- At the top of the inclined plane hold the Slinky so that it is bent over, making an upside-down U. Let the lower part of the Slinky just barely touch the plane. (This may mean that you are holding around half to two thirds of the Slinky's coils on the upper part of the plane.) Why do you think you should hold the Slinky this way?
- Release the Slinky and have your helper time how long it takes the Slinky to reach the bottom of the plane. Also count how many flips the Slinky does during this time. Tip: Make sure the Slinky doesn't tumble down the plane but actually flips end over end; do not count any of the "walks" in which the Slinky tumbled.
- How long did the Slinky take to reach the bottom at this angle, and how many flips did it make? Write down your results.
- Repeat this at least four more times, each time releasing the Slinky from the same spot at the top of the inclined plane, timing it and counting its flips. How long did it take in these other trials, and how many flips did it make? Write down your results.
- Adjust the inclined plane so that it is at a 20-degree angle. Use the protractor to confirm this.
- Repeat the experiment five times at the 20-degree angle, each time releasing the Slinky from the same spot, timing it and counting its flips. At a 20-degree angle, how long did it take the Slinky to go down the plane, and how many flips did it make? Write down your results for each of the five walks.
- Adjust the inclined plane so that it is at a 25-degree angle, using the protractor.
- Repeat the experiment five times at the 25-degree angle, each time releasing the Slinky from the same spot, timing it and counting its flips. At a 25-degree angle, how long did it take the Slinky to go down the plane, and how many flips did it make? Write down your results for each of the five tries.
- At which angle did the Slinky make the greatest number of flips on its walk? At which angle did the Slinky take the fastest walk?
- Extra: In this activity you investigated how a Slinky walks down inclined planes at

15-, 20- or 25-degree angles, but you can change your inclined plane to create a much smaller or greater slope than these and investigate how well the Slinky walks at the

- Extra: A small Slinky, like a Slinky, Jr., might walk down an inclined plane differently than a larger version. Similarly, a plastic Slinky might travel differently than a metal one of the same size. Pick the angle that worked best in this activity and separately try two different types of Slinkies, either different sizes made of the same material or the same size but made out of different materials. How do the different Slinkies walk down the plane? Does one make more flips or travel faster than the other at the same angle? Why do you think this is?
- Extra: There are many ways to use a Slinky to explore different scientific concepts. One activity to try is to put the two ends on the floor and jump. Can you use the Slinky as a wave detector this way? Alternatively, try wiggling the Slinky back and forth. What can you learn about compression waves by doing this? You can even bang on the Slinky to generate sound. Can you make different pitches? Slinkies have also been used as giant antennas. Can you think of a way to explore using a Slinky as an antenna? What other scientific Slinky uses or investigations can you think of doing?

Observations and results

Did the Slinky do the greatest number of flips on its walk down the inclined plane when it was at a 15-degree angle? Did the Slinky travel fastest down the inclined plane when it was at a 25-degree angle?

Gravity and its own momentum keep the Slinky moving down the inclined plane, and these forces are related to how the Slinky behaves when traveling at different angles. When the Slinky walks down something relatively steep, such as the inclined plane at a 25-degree angle compared with the 15-degree slope, the Slinky should travel faster as gravity pulls it downward. Depending on the exact conditions, this may take about one third of the time that the Slinky requires at a shallower angle, but the Slinky will not make as many flips on this speedy walk. When the Slinky walks down a surface that is not as steep, such as the inclined plane at 15 degrees compared with 25 degrees, the Slinky should flip more (possibly around two to three times more). When traveling on a 20-degree inclination, the Slinky's speed and number of flips should be in between these two extremes. The exact conditions used in the activity, such as the smoothness of the plywood surface and Slinky's condition, can also affect how the toy

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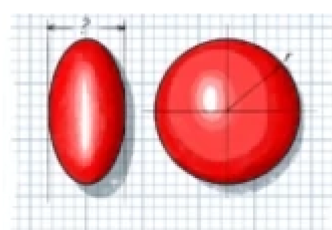

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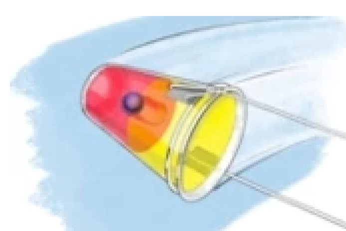

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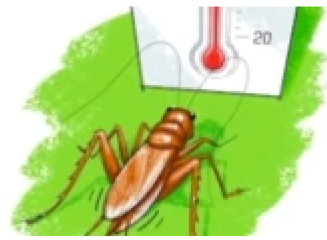

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