PHYSICS AROUND THE HOUSE

MATERIALS:

2 Large paperback books or phone books
2 stacks of Sticky Notes (Post Its)
Soda Can
Water
Box of Nails
Hammer
Scrap of Plywood
Copy Paper
Tissue Paper

VOCABULARY:

Physics	Force	Weave	Friction
Gravity	Engineering	Math	Center of Gravity
Exponential Growth	Resistance	Change	Balance

PHONE BOOK FRICTION PAGES DIRECTIONS:

1. Lay 2 very thick paperback books next to each other on a table.
2. Open the books to the page with edges of the books touching each other.
3. Weave all of the pages of the two books together so the books are woven together.
4. Have one person grab each book and try to pull them apart. Can you do it?

THE STEAM BEHIND THE EXPERIMENT:

The friction between two objects determines how difficult it will be to slide one object across another. Friction accounts for how your feet move across grass, for example, compared to how an ice skate moves across ice. Scientists use both the **coefficient of friction** and measurement of **normal force** to talk about how much friction exists between objects. Phone books are traditionally large but have very thin paper. When a few pages are interleaved, you may find the books pull apart easily. But the results change as you interleave more and more pages. Normally, there is not very much friction between two pieces of paper. However, when you interleave the pages of two books, they behave like a Chinese finger trap. The harder you pull, the harder the pages get squeezed together, increasing the normal force. The more pages you add, the larger this effect becomes. This results in a huge increase in the friction force, making them nearly impossible to pull apart.

MAKE IT AWESOME:

Try doing this with a stack of Post It Notes!

EXTENSIONS:

1. Try doing the experiment with different sized books.
2. What other changes can you come up with for this experiment?

WEBSITES AND VIDEOS:

1. Video: https://youtu.be/U-8mW_gD8Xw?si=LWAoS5qXPkD45W6u
2. Website for Sticky Note Demo: https://www.sciencebuddies.org/stem-activities/notepad-friction?from=Blog

FOLDING PAPER DIRECTIONS:

1. Fold a piece of copy paper in half.
2. Fold it in half again.
3. Keep repeating until you cannot fold it anymore. How many folds were you able to get?

THE STEAM BEHIND THE EXPERIMENT:

It is widely believed that a single sheet of paper cannot be folded in half more than seven times, regardless of its finish, size, or weight. Each fold doubles the number of paper layers. the equation 2x = total layers of paper, where x = number of folds. So, is the seven fold limit fact or fiction? Well, it's a bit of both. For the average person, the limit stands true. However, with a larger sheet of paper, you can indeed surpass the seven fold barrier. But be warned, as you fold more times, the physical resistance builds up, making it increasingly difficult to continue. Additionally, the size of the sheet must be significantly increased before attempting an extra fold.

MAKE IT AWESOME:

Try doing this with a sheet of tissue paper. How many folds can you get?

EXTENSIONS:

1. Try doing the experiment with different sizes and types of paper.
2. What other changes can you come up with for this experiment?

WEBSITES AND VIDEOS:

1. Video: How Folding Paper Can Get You to the Moon: https://youtu.be/AmFMJC45f1Q
2. Website:

CENTER OF GRAVITY WITH NAILS DIRECTIONS:

1. Hammer one of the nails into the center of the block of wood. It's a good idea to measure and predrill the hole to avoid splitting the wooden block. It's important that this nail be standing as straight as possible.
2. Place the wood block flat on a desk or table. The challenge is to balance all of the nails on the standing nail in the wooden block. To win the challenge, none of the 11 nails may touch the wood block, the desk or table, or anything else that might help hold them up. No additional equipment other than the wood block and the nails may be used.
3. Need help? The trick to balancing the nails has to do with their center of gravity or balancing point. Lay one nail on a flat surface and place the other nails across this nail, head to head as shown in the photograph. Finally, place another nail on top of this assembly, head to tail with the second nail.
4. Carefully pick up the assembly and balance it on the upright nail.

THE STEAM BEHIND THE EXPERIMENT:

Gravity pulls any object toward the center of the Earth as if all of its weight were concentrated at one point. That point is called the **center of gravity**. Objects fall over when their center of gravity is not supported. For symmetrical objects like a ball or a meter stick, the center of gravity is exactly in the middle of the object. For objects that are not symmetrical, like a baseball bat, the center of gravity is closer to the heavier end.

The stability of the nails depends on their center of gravity being right at or directly below the point where they rest on the bottom nail. Add too many nails to the left or right and they become unstable and fall off.

WEBSITES AND VIDEOS:

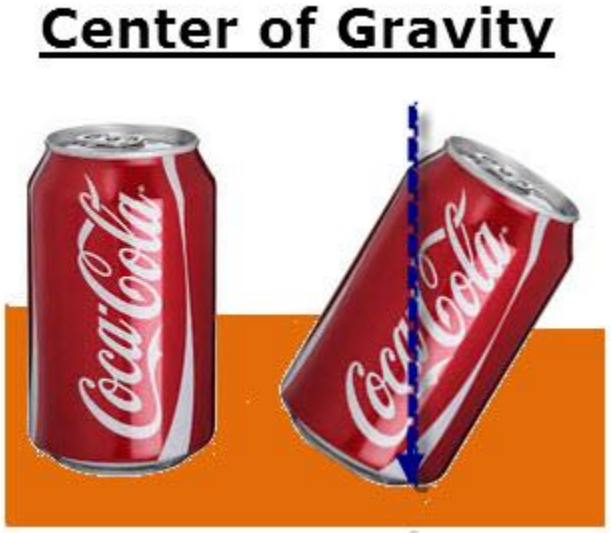
1. Video and Website with Steve Spangler: https://stevespangler.com/experiments/balancing-nail-puzzle/#:~:text=The%20stability%20of%20the%20nails%20depends%20on%20their,right%20and%20they%20become%20unstable%20and%20fall%20off.

SODA CAN BALANCING DIRECTIONS:

1. Pour about 1/2 cup of water into the soda can.
2. Lean the can over until it is able to balance at an angle.

THE STEAM BEHIND THE EXPERIMENT:

The center of gravity (center of mass) is the point on an object that when supported on that spot, the object will balance.
A line through the center of gravity of an object is always vertical. Note that the leaning soda can in the diagram is balanced where the center of gravity of the can touches the table. The volume of liquid in the can is such that a line through the center of gravity (center of mass) of the can passes though the bottom of the can as shown.
A tilted object will not fall over as long as the line through its center of gravity does not fall past the base of the object.



MAKE IT AWESOME:

Try the experiment with different sizes of cans.

EXTENSIONS:

1. Try using different amounts of water in the cans.
2. What other changes can you come up with for this experiment?

WEBSITES AND VIDEOS:

1. Video: https://youtu.be/HxBxtjwhUn8

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