Tinkering with Tops

IOWA REGENTS' CENTER FOR EARLY DEVELOPMENTAL EDUCATION

Useful Materials to Gather
variety of tops (essential)
objects that spin
materials to make tops

PURPOSE OF THE STUDY OF SPINNING

Is it worth our and our children's time to grapple with rotational motion? Experts will tell you that the physics behind spinning tops is complex. Spinning tops illustrate the concept of angular momentum, which is the amount of rotation an object has based on shape, size, and speed. A very nuanced understanding of this is necessary in careers such as aeronautics, wind energy, and in medical applications such as the rotational motion in joints. Aerospace engineers design satellites to spin in a specific way that do not allow them to tumble out of control. Automotive engineers design car parts to spin in a specific way that does not allow them to come apart. Mechanical engineers design machines to stay balanced as they spin. The even more complex physics of rotational motion at work in gyroscopes are utilized in innovators of cell phones and Wii games.

However, we engage with rotational motion on a daily basis through our use of appliances such as blenders, salad spinners, and drills. Who has not grappled with an unbalanced washing machine attempting to enter the spin cycle? There has always been a fascination of things that spin that draws one into close observation of what is at work. Why is a football pass more accurate when the thrower is able to put a spin on the ball? Interest in rotational motion begins early on with the allure of rotation in pinwheels, yo-yos, sit-n-spins, merry-go-rounds, carousels, wheels on bikes, skates, skateboards and toy cars, Whee-Los, Frisbees, hula-hoops, gyroscopes, and most recently, fidgets. However, tops have been an interest for thousands of years. For example, clay tops have been found in the Middle East that date back to 3500 BC.

Tops have four basic features. 1) a tip or point; 2) a shoulder; 3) a crown; and 4) a body. Tops can be sorted into five categories: a twirling top, throwing top, whip top, supported top, and a pump top.

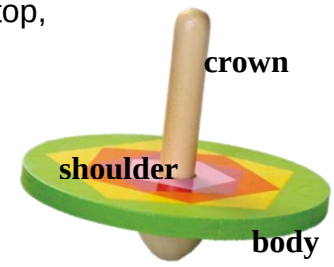
twirling

throwing

whip

supported

pump



point

Tops spin indefinitely on a pointed axis until friction eventually kicks in and causes them to spin slower and to lose enough speed to make them wobble and fall. Tops spin on a single axis and are the most basic form of gyroscopes. The *linear* speed of a top, or any rotating object, is greater on the outside, further from the axis (center), but the *rotational* speed is the same for any point on the object (all parts make the same # of rotations in the same time interval). Young children cannot understand the physics in great detail, but they can engage in science and engineering practices to understand what influences a top's balance, the length of the spin, and the physical appearance of a top in motion vs a top at rest.

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Children's Interest in Tops as a Focus of Study

High quality STEM experiences capitalize on children's prior experiences and their interest in the world and how it works. Most children have had experiences with spinning. They spin in circles to see how long it takes to get dizzy. They spin when wearing loose shirts or skirts to watch them twirl, they sit in a swing and turn in circles until the chain is twisted tight and then let it unwind as they twist in the opposite direction. Some children may have been given tops or may have experimented with spinning other objects. Spinning toys are fun to watch and challenging to experiment with.

In this STEM investigation, we will center on children's interest in tops. Tops are a rich investment of time in STEM because the fulfill the four requirements of a rich STEM activity: 1) Children can **produce** the action themselves; 2) the result of their action is **immediat**e; 3) the result of their action is **observable**; and 4) there is something children can **vary**. Children can **produce** the action of the top on their own with an **immediate** result that is **observable**, and they can **vary** either their actions in spinning, or with the right materials and observant teacher, the construction of the top.

Beginning the Study of Spinning

Set a Variety Of Tops Out at a Center: One way to introduce spinning as a classroom activity is to collect a variety of tops in a basket and place the basket on an empty table. Include tops made of different materials, tops with long and short spindles, tops with strings, and tops with interesting designs that change when they are spinning. Add lunch trays or use tape to secure a pool noodle to the edge of a low table to help contain spinning tops. line the edge of a low table with pool noodles taped to the edge to help with containment. As children spin a variety of tops, they will begin to notice the differences and similarities in how the tops spin. Observe the ways that they spin the tops and if they use a different spin with a new top. Which ones are they drawn to the most?

Capitalize on a Child's Fascination With Spinning Objects
Children will often spontaneously spin objects. Too often, we teachers view this as "off task" behavior and redirect them. Instead, we can respect and capitalize on their interest and curiosity in exploring how the world of objects works. Begin by calling the children together to examine and discuss what the child is doing and noticing. Web around a phrase such as: *Things That Spin*. Challenge them to look for things that spin at home and to bring them in to create a museum display. The museum can serve as a context for categorization. Finally, set out the basket of tops at a center and introduce them to a place where they can investigate them.
-Or-
Make a KWL chart entitled: *What do we think about **things that spin*** – or – ***tops***?
After collecting children's ideas, present them with the basket of a variety of tops and introduce them to a place where they can investigate them.

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Questions and Comments to Make

- What do you notice about these tops when you make them spin?
- What surprises you?
- What delights you?
- What frustrates you?
- What rends do you notice?
- What happens when you spin your top on different surfaces? Why do you suppose that happens?
- Which top spins the longest? Does your friend agree with you?
- Which tops are the hardest for you to spin? How would you change it to make it easier?
- Is there a way you can get several tops going at the same time? How many do you think you can get going at once?
- What happens when more than one spinning tops are going at the same time? What happens when they touch or crash?
- Are there tops that spin for the same length of time?
- How could you make them spin longer?
- Can you find other objects that you can spin?
- How are these tops different? How are they the same?
- Could you show me another one like that?

Extending the Study of Spinning

Making tops may interest children after they have had experience with a variety of tops. As children make tops, they will be able to investigate:

1) What affects a top's ability to spin?
   Children can consider the weight of the body, the weight distribution on the body; the size of the body; where the body is on the spindle; the surface on which the top is spinning.
2) What do you notice about how a top looks as it spins in contrast to how it looks when it is still?
   Children can notice that regardless of the shape of body, the top will look round as it spins fast; the design on the surface of the top changes when it spins; that colors blend together as the top spins (for example – a top with yellow on one side and blue on the other will appear green when it spins)

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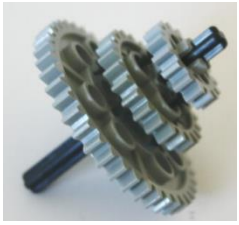
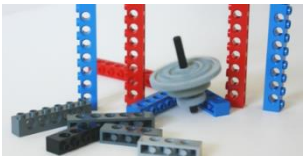
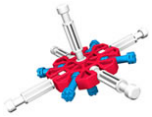
EXAMPLES OF MAKING TOPS

Simple Wooden Tops	
	These tops were often made by children at the Freeburg Early Childhood Program. All that is needed are wooden wheels, wooden dowels, a pencil sharpener, paint, and sandpaper. Additional problem-solving challenges appear when children are provided different sizes of wheels and dowels from which to select. Below is a blogger with similar ideas. http://kleas.typepad.com/kleas/2011/02/simple-wooden-tops.html
Penny Spinners	
	Museum shops often sell wooden discs with a slot in the middle. By inserting a penny into the slot, children create a top that spins on the edge of the penny. The blogger below has figured out this can be recreated inexpensively with cardboard. The cardboard allows children to explore how designs affect (or not affect) how the top looks when it spins. https://frugalfun4boys.com/2016/01/04/penny-spinners-tops-kids-can-make/
Lego Tops	
	One blogger found young children could use Lego gear wheels and a Lego 6 Stud Axle piece to create a top. Children can set up long narrow Lego pieces to see how many it can knock down in one spin. https://littlebinsforlittlehands.com/homemade-lego-skittles-game/ 
K'NEX Tops	
 	We found children can make tops out of K'NEX pieces as well as Legos. Children are often surprised that a) square tops can spin and b) a square top looks round when it spins.
CD Tops	
	With a low temperature hot glue gun, marbles, water bottle caps, and old CDs or DVDs, children can make tops with designs that seem to disappear when they are spun. https://buggyandbuddy.com/cd-spinning-top/
Perler Bead Tops	
	This blogger uses Perler beads to make tops with children. Children can explore with color patterns as well as symmetry in spinning tops made with Perler beads. https://babbledabbledo.com/diy-toys-spinning-tops-magical-disappearing-colors/