The Great Spinners

Mission Concept: Students will build a top out of everyday materials. Their challenge is to design and build a spinning top that can spin the longest. Students investigate factors which affect the length of time a toy top spins.

Mission Objective: What keeps tops spinning for a long while?

Resources:

- Build Tops with Everyday Objects: https://www.youtube.com/watch?v=9s0oAjU0b5c
- YouTube: How to Make Homemade Spinning Tops using plastic bottle caps and toothpicks by "TheLittleWoodHouse": https://www.youtube.com/watch?v=ue5zd0ef3T4
- YouTube: How to Make CD Spinning Tops – Simple and Easy by "Specific Love Creations": https://www.youtube.com/watch?v=E7cLGQw0vow

Materials to have available

- Cardboard shapes (of different sizes) with pencil through the center
- Raw and boiled eggs
- Water bottle caps with skewer or toothpick through the center
- Plastic container lids with skewer or toothpick through the center
- CD's (recycled compact discs)
- Water bottle/juice bottle caps
- Nail (small size for skewer or toothpick) & hammer to punch holes in caps
- Glass Marbles (WalMart; in bulk from Oriental Trading Co. www.orientaltrading.com)
- Round toothpicks and or skewers
- Small party favor tops (can be used as points on their tops)
- Cardboard pieces and/or paper plates
- Pennies or washers (for added weight)
- Hot glue guns or another type of quick drying craft glue
- Timers (optional)

Exploration:

1. On the bulletin board, post the mission objective to guide students' thinking throughout the lesson(s). Announce to class that at the end of these lessons, "The Great Spinner Contest" will be held to find the toy top which spins for the longest time. They will each be designing and constructing their own spinning top. Discuss definition of *spin – to rotate around a visible or invisible axis*.
2. Students observe objects (examples: raw egg, boiled egg, water bottle cap skewered through the center, plastic container lid skewered through the center, corrugated cardboard square skewered through the center) provided by the teacher. They predict which spins the longest and describe why they think so. Students spin (or try to spin) each object and check their prediction.
3. Discussion with Class
   Based on their experience spinning common objects, the class lists factors which affect the spin. (shape, size, mass, height, how it was spun) A discussion ensues:
   - Which shape seems to produce most stability?

- Does the size (diameter) affect how long the top spins?
- How does the mass affect how long it spins? Does it matter where the mass is placed? Why does a raw egg spin better than a boiled egg? Location of mass?
- Both eggs did not have a point on which it spins. How does this affect the spin?

Explanation and discussion:

- Forces which act against the spinning top: friction (Friction on the surface and against the air reduces the rotational speed) and gravity (attraction between earth & top pulls it downward)
- Angular momentum
  Review with class *Newton's first law of motion*: an object at rest remains at rest and an object in motion continues in motion in a straight line, unless acted upon by another force. Angular momentum is similar.
  Angular momentum: a rotating object will continue to rotate exactly the same way (with constant angular velocity) unless an outside force causes it to change. By spinning the top, you have given the top angular momentum. The angular momentum of a spinning top resists gravity. The greater the angular momentum, the greater the force necessary to change its direction or motion. Because angular momentum is the product of mass, velocity, and radius of a rotating object, to increase it, mass, velocity and/or radius could be increased.
  Example of real life application: A bicycle which is not moving will fall over, not stand upright. If a force is applied to get the wheels spinning, the wheels have angular momentum. The faster the bicycle wheels spin, the greater the angular momentum so remaining upright is easier and a greater torque (force) will be needed to slow down or change the direction of wheels & bicycle.

4. Activity: Students design and build a top that they think will spin a long time. Materials should be made available for them. As students design their tops
   - Ask what factors they should consider so their top will spin a long time. (mass, method to increase rotational speed, size, shape, height)
   - Explain to students that the body of their top can be made of cardboard, plastic lids, paper plates, CD's etc.
   - Optional: Show students how they can construct a top with a CD. The top with the CD can have a marble on which to spin and a glued bottle cap for the spinner or even a small plastic top (usually a party favor) at the hole to be the spinner and point. Show students how to construct a top with a juice bottle cap. A hole is punched in the center of the bottle cap, and a toothpick or skewer is inserted.

   Students should test their tops and modify until they are satisfied. Teacher should continue to encourage deeper thinking with questions.

Mission Report: The Great Spinner Contest

Conduct preliminary contest and identify the longest spinning top of the subgroups. Then conduct a final contest to find the longest spinning top that has bragging rights.

Debrief: Discuss the attributes of the winning spinning top.

Having participated in the designing and construction of their own tops, and having observed the various spinning tops, students will respond to the Mission objective with varied thoughtful answers.