Balancing Bicycles

Don't look down! Do you remember practicing how to balance when learning to ride a bike? Can you imagine riding a bike on a tightrope high in the air? Discover how weights and a low center of gravity can keep you on the rope.

TEKS:

SCI 3.6A: The student is expected to observe forces such as magnetism and gravity acting on objects.
SCI 4.6D: The student is expected to design a descriptive investigation to explore the effect of force on an object such as a push or a pull, gravity, friction, or magnetism.
SCI 8.6A: The student is expected to investigate and describe applications of Newton's three laws of motion such as in vehicle restraints, sports activities, amusement park rides, Earth's tectonic activities, and rocket launches.

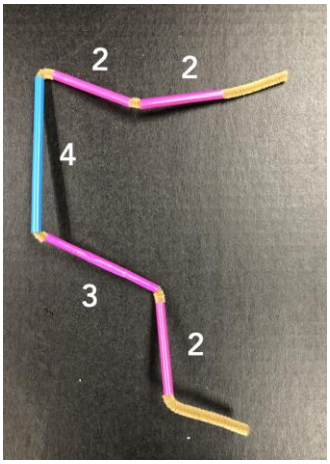
Materials:

- Cardboard pieces
  - 1 1 x 3-inch piece of cardboard
  - 2 3 x 5-inch pieces of cardboard
- Cardstock
- Hot glue gun and hot glue sticks
- Index card
- Nail
- Packing tape
- 4 pipe cleaners
- 2 plastic bottle caps
- 2 plastic spools (purchase here)
- Scissors
- Straight straw pieces
  - 9 2-inch pieces of straw
  - 2 3-inch pieces of straw
  - 3 4-inch piece of straw
- 1-inch Styrofoam ball
- 3 feet of string
- 3 toothpicks
- Unfolded wire hanger or thick wire
- Washer weights

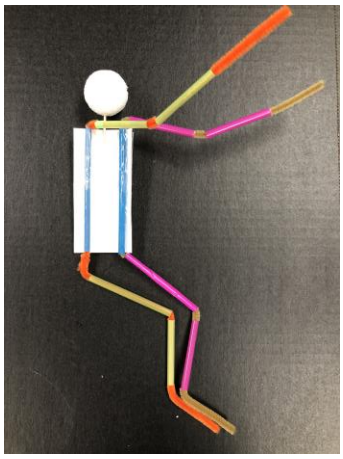
How To:

Making the Bicycle Rider

1. Attach two pipe cleaners lengthwise by tightly twisting one end of each pipe cleaner together.
2. Feed the straws onto the attached pipe cleaners so they are in the following order from top to bottom: two 2-inch straws, one 4-inch straw, one 3-inch straw, then one 2-inch straw.
3. Bend the pipe cleaner to form one side of your rider's body, as depicted below. Leave 2 inches of pipe cleaner on either side of the end straws, and trim off any excess.



4. Now repeat steps 1-3 to build the other side of your rider's body.
5. Cut an index card into a 2 x 4-inch rectangle.
6. Line up two sides of the body so the 4-inch straw pieces are about 1 inch apart and centered along the length of the index card. Use packing tape to secure the 4-inch lengths of straw to the index card.
7. Stick a 1-inch Styrofoam ball onto a toothpick and place the other open, pointy end of the toothpick between the two straw configurations. Secure the toothpick to the index card with packing tape. The bicycle rider will look something like this:

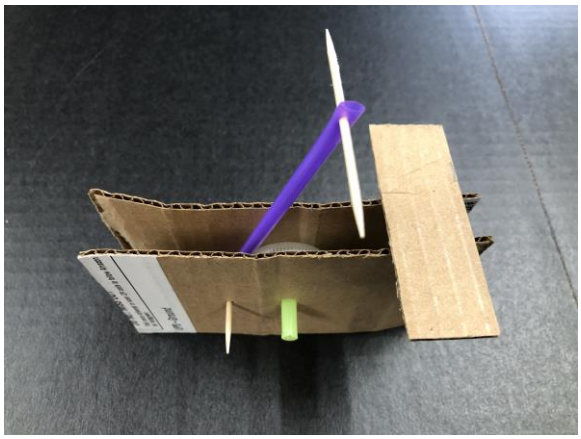


Making the Bicycle

1. Take the two 3 x 5-inch pieces of cardboard and, using the nail, make a hole in the middle of the long sides of both pieces. **Safety: Be careful pushing the nail through the cardboard. Make sure to keep your hands away from the backside/area of the hole as it is being made.**

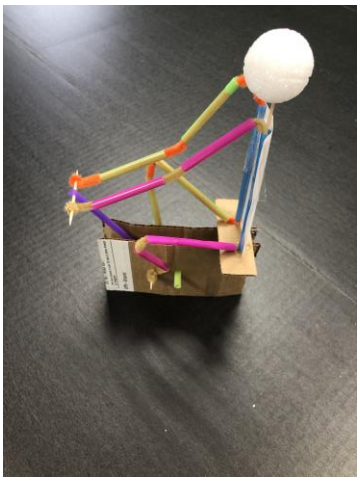
2. Use the nail to make a hole in the center of each bottle cap. **Safety: Be careful pushing the nail through the bottle cap. Make sure to keep your hands away from the backside/area of the hole as it is being made.**
3. Thread a 2-inch straw through one cardboard hole, then through a bottle cap with the top side facing the middle.
4. Thread the straw through the other hole punched bottle cap, top side flat against the first cap.
5. Lastly, thread the straw through the hole in the other 3 x 5-inch cardboard to sandwich the bottle caps in the middle. This will act as your bike's base.

6. To create a seat for your bike, hot glue the 1 x 3-inch piece of cardboard perpendicular to one end of the bike's base. The 1 x 3-inch piece should lay flat across the base so the rider can sit on it later. **Safety: An adult should assist when using hot glue.**
7. On the end of the bike's base opposite of the seat, use a toothpick to make a hole in each side of the base. The holes should be across from one another and 1 inch in front of the bottle caps. **Safety: Be careful pushing the toothpick through the cardboard. Make sure to keep your hands away from the backside/area of the hole as it is being made.**
8. Using a toothpick, make a small hole through each end of a 4-inch piece of straw. **Safety: Be careful pushing the toothpick through the straw. Make sure to keep your hands away from the backside/area of the hole as it is being made.**
9. Thread one of the toothpicks halfway through the hole in the base, then thread it through the hole at one end of the 4-inch piece of straw. Continue threading the toothpick through the other side of the base so the straw is in the middle of the two 3 x 5-inch pieces of cardboard. This will act as the pedals of the bike.
10. Thread another toothpick through the holes at the opposite end of the 4-inch straw. This will be the bike's handles. Your bicycle should look something like this:



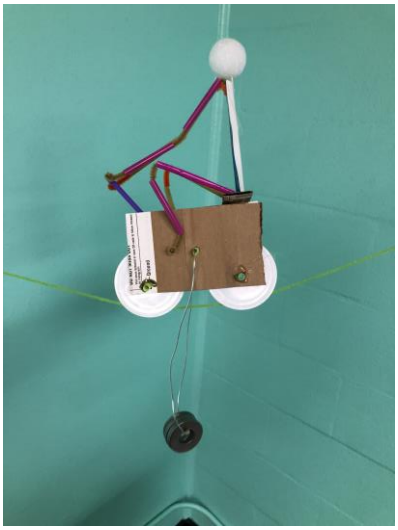
Putting it all together

1. Take the rider you made and have them "sit" on the 1 x 3-inch piece of cardboard. Wrap the excess pipe cleaner at their "hands" around the toothpick at the top of the 4-inch piece of straw, and wrap the excess pipe cleaner at their "feet" around the toothpick threaded through the 3 x 5-inch pieces of cardboard. Use the hot glue gun to glue the bottom of the rider's torso onto the 1 x 3-inch cardboard seat. **Safety: An adult should assist when using hot glue.**



2. Use a nail to create holes approximately one inch from the front of your bicycle along the bottom edge of the base. Slide one of your 2-inch straws through one piece of cardboard, then through one of your plastic spools, and finally through the other 3 x 5-inch cardboard. This will be your bicycle's front wheel. **Safety: Be careful pushing the nail through the cardboard. Make sure to keep your hands away from the backside/area of the hole as it is being made.**

3. Repeat step 2 approximately 1 inch away from the back of your bicycle to create your bicycle's back wheel.
4. Take the unfolded wire hanger or thick wire and shape it into a thin rectangle, be sure the loose ends of the wire meet along a short side of the rectangle. Thread the wire through the straw in the middle of base making sure that the short end of the rectangle with the loose ends of the wire are hanging at the bottom.
5. Tape one end of the string on a wall. Hold the other end so that it is taught and place the wheels of your bicycle on the string.
6. Put washer weights on the bottom of the wire rectangle and secure the wires to each other so that the weights won't slide off.
7. Move one end of the string up and down to watch the person bike along the track. The long wires of the rectangle should be on either side of the string and connect at the bottom.



STEM Explanation:

Gravity is the unique force that allows for the bicycle to balance! A force is a push or pull, and gravity is the force that pulls objects towards the center of the Earth. You may have been surprised that the bicycle rider does not fall from the track when you move one end of the string. This occurs because the bicycle has a low center of gravity and is more stable than if the center of gravity was higher. Center of gravity is the location on an object where the majority of the force of gravity acts on the object. We created an artificially low center of gravity using the weights! When we added the weights, it added more downward force to stabilize the bicycle. When the center of gravity of an object is located and controlled, like in this activity, the object will not fall.

Career Connection:

Automotive engineers design the vehicles that we use in our daily lives. They follow the engineering process to plan, create, and test vehicles that meet safety, style, comfort, and other consumer needs.

Resource:

http://www.arvindguptatoys.com/toys/Balancingbicycle.html

