

RAFT IDEAS

Topics: Balance, Cause and Effect, Center of Mass, Stable Equilibrium

Materials List

- ✓ File folder section
- ✓ Balancing Frog die-cut (available at RAFT) or frog template (page 2)
- ✓ Pivot point piece
- ✓ Materials to make a base/stand
- ✓ Paperclips/pennies
- ✓ Hot glue gun
- ✓ Hole-punch
- ✓ Scissors

This activity can be used to teach:

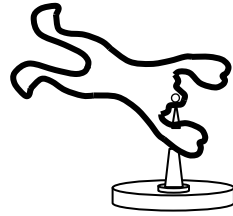
Next Generation Science Standards:

- Forces & Motion (Grade K, Physical Science 2-1, 2-2; Grade 3, Physical Science 2-1; Middle School, Physical Science 2-2)
- Gravity (Grade 5, Physical Science 2-1)



Gravity Defying Frog

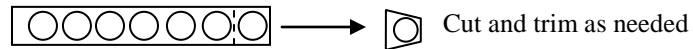
A Balance Investigation



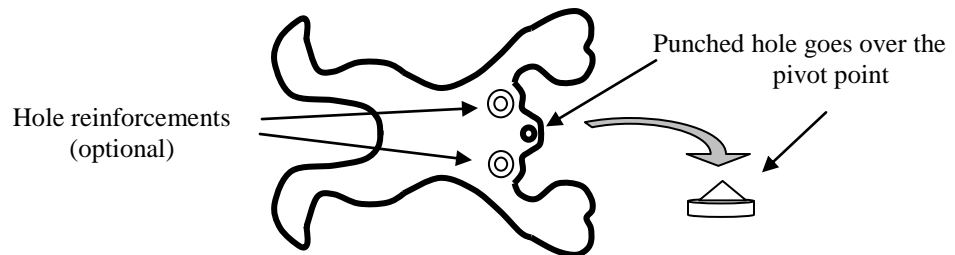
Students can investigate cause and effect, center of mass, balance, and stable equilibrium while they create this fascinating, scientific toy!

Assembly

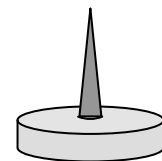
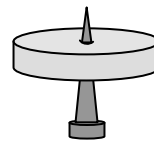
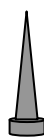
1. Cut the frog shape from a piece of file folder or heavy weight paper. Use the balancing frog die-cut or else hand cut the frog using the pattern on page 2.
2. Cut apart the plastic pivot points and trim as needed.



3. Use a hole-punch to make a hole in the frog's head, centered and near the edge.



4. Place the plastic pivot point with the pointed side pointing up. Place the frog so the hole in the frog's head is over the pivot point and then press down. Secure the plastic pivot piece in place by pushing down around the edges of the hole. Pushing down with a tube or cap that has an opening slightly bigger than the hole can accomplish this easily and quickly.
5. Poke a pipette tip into the center of a piece of foam that is several inches round or square to create a stand/base as shown.



Optional – Use a pair of hole reinforcements to give the illusion of “eyes.” Students can also individualize their frog by decorating the frog with markers, stickers, etc.

To Do and Notice

1. Have students investigate, by trial and error, how to make the frog balance on the pivot point. They will need to add weight to the frog using jumbo paperclips. Where do the weights need to be positioned to create a “gravity defying” frog?
2. Once the location is found students can (hot) glue pennies (or other weights) to the undersides of the front feet, replacing the paperclips. White glue can be used but the glue would need to dry overnight. Using pennies will make the frog a more puzzling toy since the drooping feet will make the added weights less noticeable.

The Science Behind the Activity

A cardboard frog, or any other 2 or 3-dimensional shaped object will balance on a point if the point and the object's center of mass are aligned. If the center of mass, also called the center of gravity, is **below** the balancing point, then the object will return to a balanced state if tipped. This is referred to as having a **stable equilibrium**. If the center of mass is **at or above** the balancing point then the object will fall if tipped unless the balance point is moved back under the center of gravity. An example of this is seen in circus balancing acts as the performer moves a hand or head to keep a weight (a spinning plate, etc.) balanced overhead on a stick.

A uniformly weighted object will balance at a centrally located point. The extra weight on the frog's front feet moves the center of mass for the frog toward the front, by the frog's head. When the extra weight is hidden from view the frog seems to "defy" gravity with most of the frog's body "hanging out," seemingly unbalanced.

Taking it Further

- Cut out other shapes and make them balance in the same way as the frog or upright.
- Ask students to explain the science demonstrated by a commercial "Balancing Bird."
- The Internet has many incorrect scientific explanations. Students need practice in identifying science fact from science fiction. For a lesson in media literacy, challenge students to search the Internet for sites that have the correct or the incorrect explanation for the "Balancing Bird" toy.
- **Optional** – Students can decorate their frogs with markers, stickers, etc.

Web Resources (Visit www.raft.net/raft-idea?isid=90 for more resources!)

- Balance and equilibrium - www.mit.edu/afs/athena/course/4/4.441/1_lectures/1_lecture6/1_lecture6.html
- "Balancing Bird" (pictured) with explanation - http://physics.bu.edu/~duffy/mech/1J20_46.html
- Paper pattern to create a balancing bird model - www.bobscrafts.com/bobstuff/balance.htm

Balancing Frog Template

