**Center of Gravity**

**Objective:** Determine the relationship among center of gravity, weight distribution, and tendency of an ATV overturn.

**Targeted Age:** Middle school and above

**Materials:**
- Corrugated cardboard
- Scissors
- String (3 to 6 feet)
- Tacks
- Ruler
- Bulletin board or rigid foam core
- Pencils with erasers
- Tape

ATVs are often used on the farm to transport heavy and bulky items from one location to another. ATVs are great work horses and make many farm chores easier. The problem with hauling items on an ATV is the extra weight alters the center of gravity (COG) of the machine. When the COG is altered the ATV is less stable and more likely to tip over if the operator does not take this shift into account when driving. Gravity is the pulling force between two objects due to their masses. COG is the balance point of the object.

Copy and glue the ATV picture, buckets, hay bales, and riders onto cardboard. Cut them out. Tie each end of the string to a tack. Tack the top of the string into a bulletin board. Attach the second tack into anywhere on the ATV cutout. Allow the ATV to pivot freely. When the cutout stops moving, line the ruler up with the string and draw a line across the entire ATV cutout. Remove the tack from the cardboard and place it in a different location on the ATV cutout. Repeat the line drawing. Where the two lines intersect is the Center of Gravity. Mark this point COG 1. Check out the accuracy of the COG by finding the place on the cutout where you can balance the object on the eraser end of the pencil. The intersecting point and the pencil eraser point should be the same place.

Tape the driver to the ATV. Repeat the COG identification as before. Add objects (buckets, hay bales, and extra riders) one at a time and repeat the COG identification. Mark each COG with appropriate labels such as COG rider, COG hay, etc. Compare the COGs. Notice the COG changes as the weight distribution changes. Discuss the extra weight of each object and how this weight changes the COG. Discuss how this change influences the stability of the ATV. Allow students to try various weights and positions to determine the changes in COG.

**Q: How does a rider on an ATV put both the rider and operator at risk?**

**A:** A person on the back of an ATV shifts the center of gravity up and backwards while the COG of a single operator is low and in the middle of the machine. When this happens the ATV is more likely to overturn, putting both the operator and passenger at risk of turning over. ATVs weigh more than the operator and injuries can take place when it overturns. The operator and passenger could be thrown off the vehicle or caught underneath.

**Q: What is the correlation between weight and center of gravity?**

**A:** An ATV is most stable when the COG is low and most centered. When people or other objects are added to the ATV the center of gravity moves toward the extra weight. This makes the machine less stable.

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