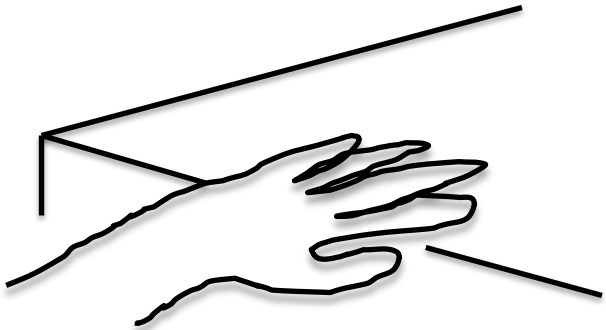
# "Action-Reaction" Contact Forces

## Teacher Printout: Station Instructions

### Station: That Tingling Feeling

Materials: None

Procedure:



1. Keep your hand flat and slap the surface of the table lightly.
2. Repeat the process, but this time, slap the table much harder. Talk with a partner about the difference between the way your hand feels after slapping the desk lightly and harder.
3. In your lab journal, copy and complete the following: The boundary for this system could be described as _____.
4. In your lab journal, copy and complete the following: The interacting objects that demonstrate action-reaction force pairs in the system are ______.
5. In your lab journal, draw two diagrams of the system to represent each trial. Show both trials, the lighter versus harder slap on the surface. Drawings can be simple line diagrams, as shown above, and do not need to be elaborate.
6. Add labeled force arrows on your diagrams. (Hint: the force arrows on one set will not be the same size as the force arrows on the other set.)
7. Title your diagrams.
8. Under the diagrams, write one statement that summarizes the evidence you were able to feel that supports Newton's Third Law of Motion.

# “Action-Reaction” Contact Forces

## Teacher Printout: Station Instructions

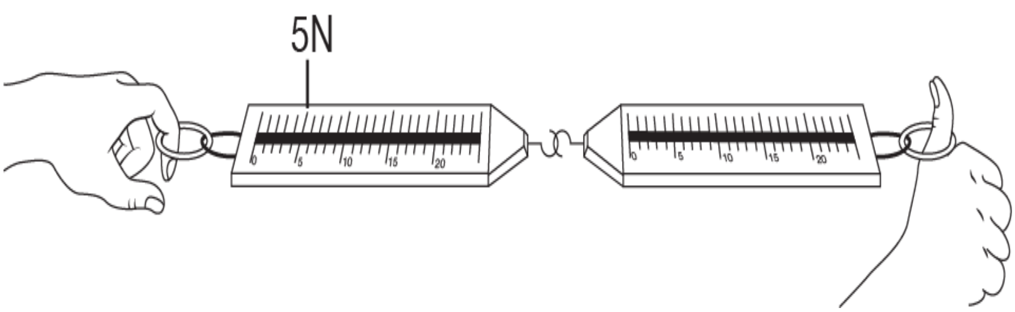
**Station: Push-Me, Pull-You**

Materials:
2-10 N Spring scales

Setup:  Place the two spring scales on a tabletop.

Procedure**:**

1. Determine a way to stabilize one of the two spring scales so that it does not move.  For example, attach the hanging ring to a clamp, or have a partner hold one end of the table and the spring scale in a stable position as shown in the diagram.




2. Hook the two spring scales together as shown in the diagram.
3. Pull on the second, nonstationary spring scale with a force of 5 Newtons.
4. Observe the reading on the stationary spring scale.
5. Pull on the second, nonstationary spring scale with a force of 8 Newtons.
6. Observe the reading on the stationary spring scale.
7. 7.  In your lab journal, copy and complete the following:  The boundary for this system could be described as _____.
8. In your lab journal, copy and complete the following: The interacting objects that demonstrate action-reaction force pairs in the system are ______.
9. Draw a diagram of the system in your lab journal.
10. Add labeled force arrows on your diagram.
11. Title your diagram.
12. Under the diagram, write one statement that summarizes how the forces interacted at the same moment when Newton’s Third Law of Motion was demonstrated.

# "Action-Reaction" Contact Forces

## Teacher Printout: Station Instructions

### Station: Newton's Body Surfing

Materials:
2 Floor scooters
1 Heavy ball or bag
Open, smooth-floored area (hallway outside classroom is ideal, if tiled)

Setup: Place the scooter and the heavy ball in an open area on a smooth floor.

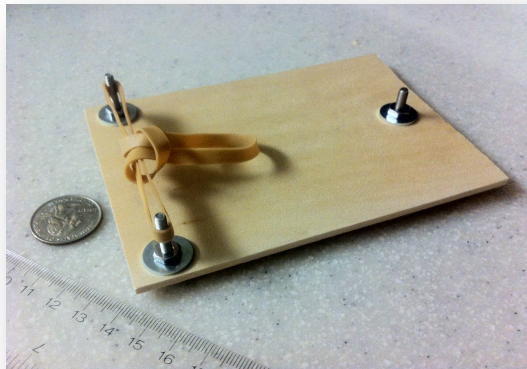
Procedure:

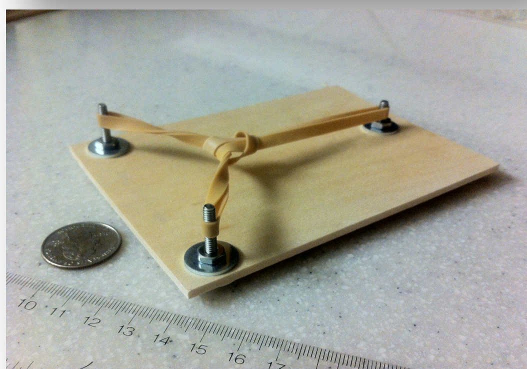
1. Sit on the scooter and rest your ankles on the second scooter. Your legs must be straight, no bending of the knees.
2. Hold the heavy ball.
3. Try to get the scooter to move backward without touching the floor, walls, or other students with your hands or feet. (Hint: you are holding a ball – remember the third law of motion.)
4. In your lab journal, copy and complete the following: The boundary for this system could be described as _____.
5. In your lab journal, copy and complete the following: The interacting objects that demonstrate action-reaction force pairs in the system are ______.
6. Draw a diagram of the system in your lab journal.
7. Add labeled force arrows on your diagram.
8. Title your diagram.
9. Under the diagram, write one statement that summarizes the evidence you were able to feel that supports Newton's Third Law of Motion.
10. What could you change about the system that would cause more movement on the scooter (still not using hands or feet on the floor, wall, or other students)? In your lab journal, answer this question using a complete sentence.

# "Action-Reaction" Contact Forces

## Teacher Printout: Station Instructions

**Station: Recoiling Slingshot**





Materials:
1 Slingshot apparatus
2 Rubber bands
1 Small bottle filled with metal nuts

Setup: Place the slingshot apparatus, two rubber bands, and bottle at station.

Procedure:

1. Loop one rubber band over the two posts at one end of the slingshot apparatus. The rubber band should not be too tight or too loose.
2. Loop the second rubber band around the middle of the first rubber band that is stretched between the two posts. Then stretch it back and loop around the third post (see pictures).
3. Loop the other end of the rubber band over the third post at the other end of the wood, to create the launching bands (see pictures).
4. Load the slingshot apparatus with plastic bottle and prepare for launch. Be prepared to WATCH the motion of each object closely. See which object moves faster, slower, a greater or shorter distance, or not at all.
5. Use scissors to cut the rubber band attached to the back end post to launch the bottle (see arrow on picture).
6. In your lab journal, copy and complete the following: The boundary for this system could be described as _____.
7. In your lab journal, copy and complete the following: The interacting objects that demonstrate action-reaction force pairs in the system are ______.
8. Draw a diagram of the system in your lab journal.
9. Add labeled force arrows on your diagram.
10. Title your diagram.
11. Under the diagram, describe and compare the motion of the bottle and the motion of the slingshot after launch.
12. Newton's law requires that equal force is applied to each object in the system, but in the opposite direction. Explain why the <u>motion</u> of each object was different in your journal.

# "Action-Reaction" Contact Forces

## Teacher Printout: Station Instructions

### Station: May the Force Be Against You

Materials:
1 Toy car, pull-back, self-winding
1 Box, long, smooth bottom
20 Marbles
1 Cardboard, strip
Salt, 5 grams

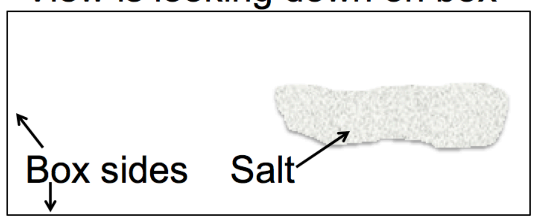
Setup: Place all materials at station.

Procedure:

1. Sprinkle a little salt in the middle on the right side of the box, just enough to hold the marbles in place. See Figure 1.
2. Gently place the marbles on the sprinkle of salt. Don't touch the box sides once the marbles are in place! See Figure 2.
3. Gently, gently, set the cardboard strip on top of the marbles without disturbing them as much as possible. It might take several tries to place the cardboard while keeping the marbles still. See Figure 3.
4. Wind the toy car. (Remember not to do anything to the tabletop that will shake your marbles, or you will have to start all over again.)
5. Gently set the wound car on the cardboard and let go (the car will travel toward the box end). WATCH what happens to the motion of the car and the motion of the cardboard strip. See Figure 4.
6. In your lab journal, copy and complete the following: The boundary for this system could be described as _____.
7. In your lab journal, copy and complete the following: The interacting objects that demonstrate action-reaction force pairs in the system are ______.
8. Draw a diagram of the system in your lab journal.
9. Add labeled force arrows on your diagram.
10. Title your diagram.
11. Under the diagram, describe the motion of the two interacting objects as a result of the action-reaction forces.

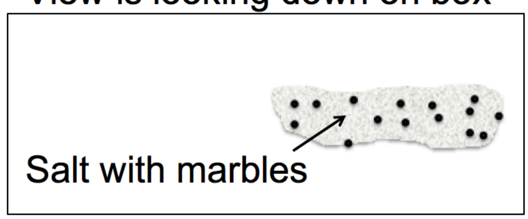
View is looking down on box

Figure 1



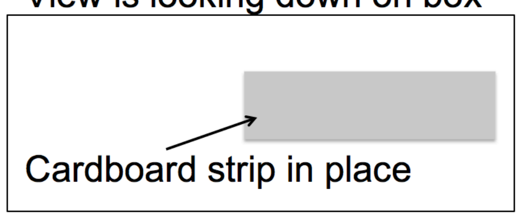

View is looking down on box

Figure 2



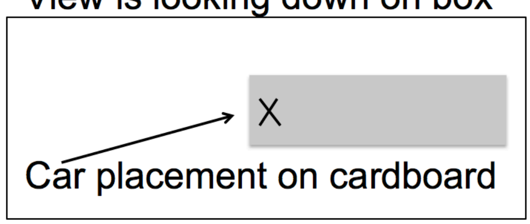

View is looking down on box

Figure 3




View is looking down on box

Figure 4



# "Action-Reaction" Contact Forces

## Teacher Printout: Station Instructions

**Station: Up, Up, and Away**

Materials:
1 Balloon (per lab group)

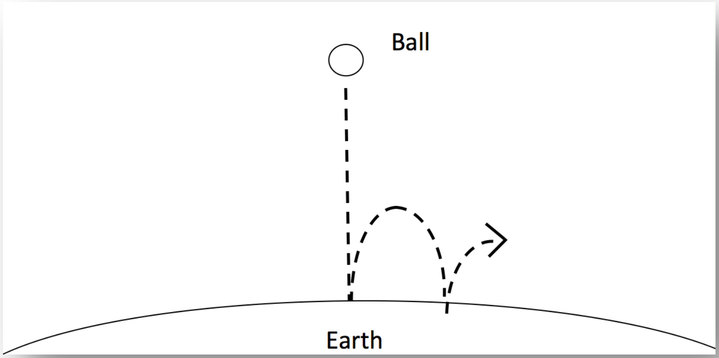
Setup: EXPECTATIONS - see bullets
- Use only one balloon per group.
- Complete this activity only ONE time as a group.
- Then throw the deflated balloon in the trash can.

Procedure:
1. Blow up the balloon. Do not tie off.
2. Release the balloon.
3. In your lab journal, copy and complete the following: The boundary for this system could be described as _____.
4. Draw a diagram of the system in your lab journal.
5. Add labeled force arrows on your diagram.
6. Title the diagram.
7. Under the diagram, describe the motion of the two interacting objects (the balloon and the exiting air) as an action-reaction event.

# "Action-Reaction" Contact Forces

## Teacher Printout: Station Instructions

**Station: Follow the Bouncing Ball, or Not**




Materials:
1 Table tennis ball
1 Clay ball
1 Meter stick

Setup: Place equal-sized balls at station.
A smooth surface floor is required.

Procedure:
1. Hold the table tennis ball exactly one meter above the floor.
2. Let go and observe the motion of the ball and the motion of Earth before and after the action-reaction event (when the ball strikes Earth).
3. In your lab journal, copy and complete the following: The boundary for this system could be described as ____.
4. In your lab journal, copy and and complete the following: System components include ___.
5. Draw a diagram of the system in your lab journal that shows the moment when the two objects interact.
6. Add labeled force arrows on your diagram.
7. Title the diagram.
8. Under the diagram, describe the motion of the two interacting objects before and after the action-reaction event.
9. Hold the table clay ball exactly one meter above the floor.
10. Let go and observe the motion of the ball and the motion of Earth before and after the action-reaction event (when the ball strikes Earth).
11. In your lab journal, copy and complete the following: The boundary for this system could be described as ____.
12. In your lab journal, copy and and complete the following: System components include ___.
13. Draw a diagram of the system in your lab journal that shows the moment when the two objects interact.
14. Add labeled force arrows on your diagram.
15. Title the diagram.
16. Under the diagram, describe the motion of the two interacting objects before and after the action-reaction event.
17. In your lab journal, copy and complete the following: The motion of Earth was not observable after the action-reaction event with the table tennis ball or the clay ball because _____.
18. In your lab journal, copy and complete the following: Although action-reaction forces on the balls and Earth were equal in magnitude and opposite in direction during each interaction, the resulting *motions* of the interacting objects depended on _____.