

## Portfolio Activity 4.5

# CONTROLLING VARIABLES: PAPER DRAGON RACES

### Materials Needed:

- A large file card and a small file card
- A rubber band
- Heavy cardboard
- A stapler
- Scissors
- A hole punch
- A paper clip
- Tape
- Metal washers

- A. Build a Maxi-Puller/Pusher and paper dragon before doing this activity.

### Building the Maxi-Puller/Pusher

The Maxi-Puller/Pusher (Berger et al., 1974) will act as a force gauge. To construct the Maxi-Puller/Pusher, fold a large file card in half lengthwise. Insert heavy cardboard between the folds of the card to add strength. Now staple together the ends of the file card. Punch a hole at one end and attach a rubber band as shown in Figure 4.4. To the free end of the rubber band add a paper clip hook. In one hand, hold the card so that the punched hole is at the top. With the other hand, gently tug down on the hook. Notice that the more you tug, the lower the hook moves along the card.

How can we measure how much an object pushes down on the Maxi-Puller/Pusher? To measure the pushes and pulls of the Maxi-Puller/Pusher, you need a way to calibrate it with equal units. Place a piece of tape down the middle of the folded file card. With nothing hanging from the paper clip hook, mark a zero on the tape beside the top of the hook. This mark shows the zero, or starting, point. Next, put one washer on the paper clip hook. Beside the top of the paper clip, mark 1W to stand for "one washer unit." Keep adding washers of the same size one at a time and mark 2W, 3W, and so on on the tape. You have now built and calibrated your Maxi-Puller/Pusher.

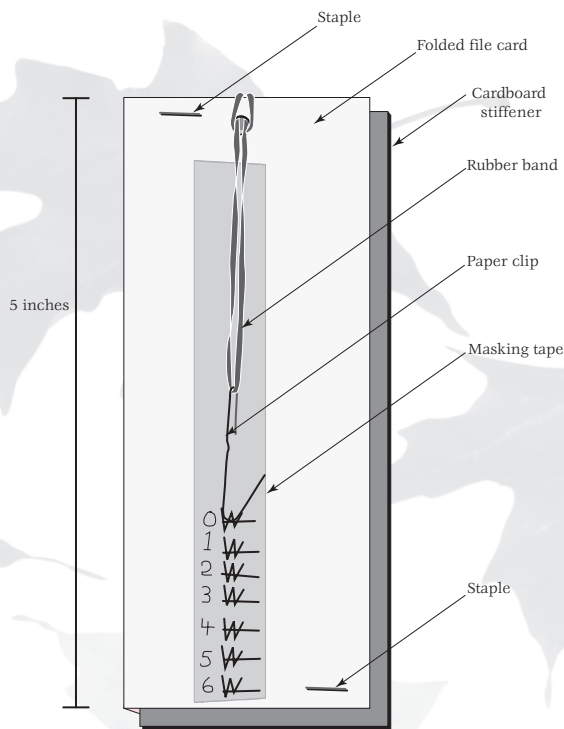


Figure 4.4 Building the Maxi-Puller/Pusher.

### Building the Paper Dragon

To make a paper dragon, fold a small file card in half and cut the top on a slant so that the shorter edge is near the fold, as shown in Figure 4.5.

- B. Now that you have your Maxi-Puller/Pusher and paper dragon, you're ready for some races. First, you need to practice. To use the Maxi-Puller/Pusher as a way of measuring "pushing" force, bend up the end of the paper clip hook to make a trigger. Set the end of the dragon in the

cradle formed by the paper clip trigger. See Figure 4.6. Use the Maxi-Puller/ Pusher like a slingshot by holding down the Maxi-Puller/Pusher with one hand and pulling the paper clip and paper dragon back with the other hand. Let go of the paper dragon, shooting the dragon forward.

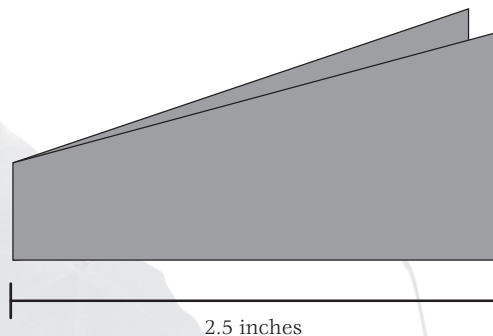
C. Conduct several races.

*Race one:* Divide the class into two groups. One group should pull the Maxi-Puller/Pusher back to the 5W mark. The other group should pull the Maxi-Puller/Pusher back to the 8W spot. Each group member should have three turns to shoot the dragon. Ask students to keep track of how far the paper dragon moves. Each group should then calculate the average distance the paper dragon moves (the sum of distances divided by the number of shots made by the group).

Now have the two groups discuss the results. What were the independent and dependent variables? Was the activity fair? What was wrong with how the contest was set up? How might you make it fair?

*Race two:* Divide the class into two groups. One group should set three paper clips into the ends of the wings of their paper dragon, and the other group should use an unweighted paper dragon. Each group should pull the Maxi-Puller/Pusher back to the 5W mark. Make sure that each group member has three turns to shoot the dragon. Ask students to keep track of how far the paper dragon moves. Each group should calculate the average distance the paper dragon moves (the sum of distances divided by the number of shots made by the group).

Have the two groups discuss the results. What were the independent and dependent variables? Was the activity fair? What was wrong with how the contest was set up? How might you make it fair?



**Figure 4.5** Building the paper dragon.



**Figure 4.6** Racing the paper dragon.

- D. What other variables could you change? With older students you could try a free-throw contest or a race instead of the paper dragon activity.
- E. Record your reflections on the activity in your portfolio.