THE DEMONSTRATION CORNER

Newton's Third Law and Water Rockets

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Having students construct and launch a water rocket is an entertaining way to investigate Newton's Third Law of motion. Students can construct the rockets at home for an in-class launching session.

Apparatus: two-litre pop bottle, range enhancers (see below), launching pad, bicycle pump with basketball-inflator "needle," rubber stopper.

Procedure for Students:
1. Find an empty two-litre pop bottle. You may glue on a "nose cone", some "fins" and anything else that you think might help your "rocket" fly farther. However, you may not use a set of "wings" or other form of lifting airfoil, like an airplane.
2. Decide how much water you want to place in the rocket. Put this much in.
3. Attach the rubber stopper firmly, and place your rocket in the launcher. Pump air into the rocket until it "fires."
4. Your "score" is the distance flown horizontally, in metres.

Notes to the teacher:
1. The launcher can be as simple as two boards, angled at 45º, with guide rails on the launch board (Fig. 1).

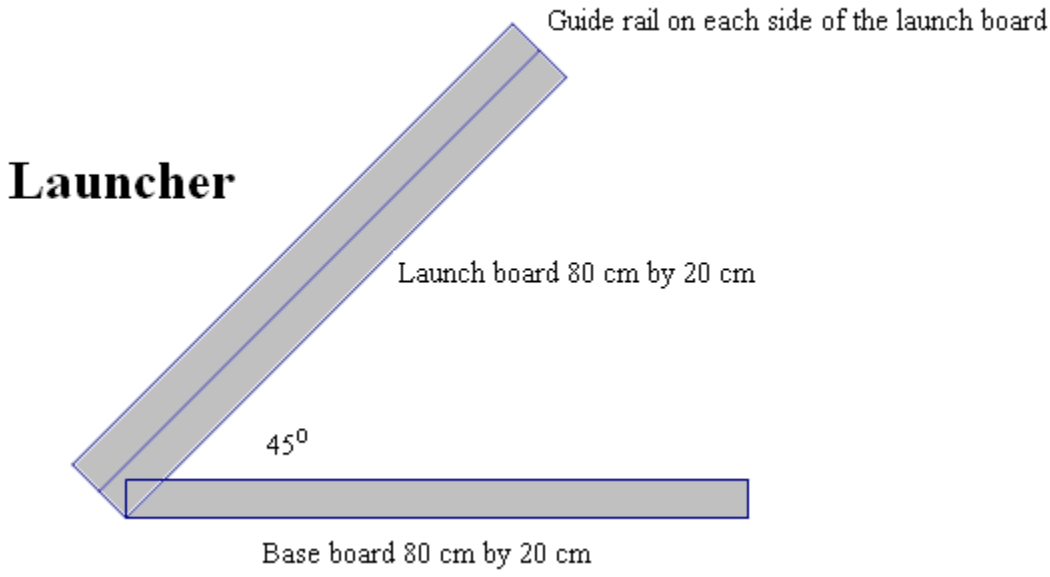

Figure 1 *A typical launcher.*

2. Ensure that the firing range is clear. A good water rocket can fly over 100 m horizontally.
3. Use a basketball inflator pushed through a rubber stopper to attach the bicycle pump to the rocket (Fig. 2).
4. I usually do not warn students not to stand directly behind the rocket while pumping. A little water won't hurt them, and will reinforce the workings of Newton's Third Law.

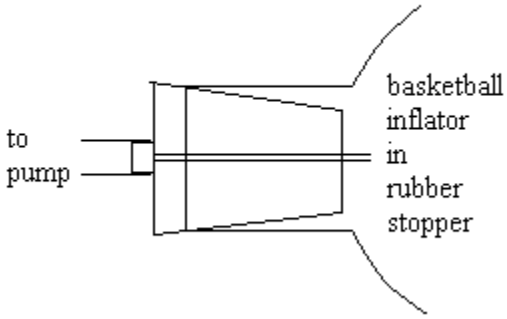

Figure 2 *Connection between the pump and the rocket.*

Possible Follow-up or Report Questions:

1. Explain how the rocket works in terms of Newton's third law.
2. Why doesn't the rocket work well if there isn't much water in it?
3. Why doesn't the rocket work well if there isn't much air in it?
4. Which mixture seems to work the best?
5. A real rocket for use in space must carry both fuel and oxygen. Why is this?

Other Notes:
1. Just after launch, a "cloud" will often form inside the bottle, and persist for several seconds. Why this cloud forms makes for an interesting discussion or research question.
2. A more sophisticated launcher can include a way of changing the angle of the two boards, allowing an investigation of range versus angle of launch.

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