3RD GRADE 4-H

AIR RACER

Create and Test an Air-Powered Race Car

Materials Needed:

Per Team of Two: Toilet paper roll, bottle caps (4), 2" x 1/5th" dowel (2), 6" rectangular stick, popsicle stick, propeller, rubber band hook, rubber band

To share with class: tape measure, blue masking tape, scissors, hole punch (2), hot glue guns (3)

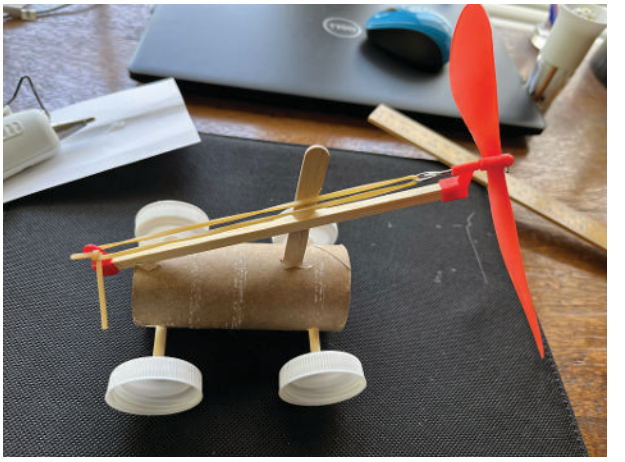
Day #1 Procedure:

Before class, plug-in hot glue guns and place something under them to catch any mess. Punch four holes, two on each side of the toilet paper rolls aligned with two holes on the other side, in order to allow the dowels to serve as axles. (You can let the team do this; however, students are famous for not placing the holes across from each other or placing them so high that the wheels end up in the air.) Make a slit, with a carpet knife for the popsicle stick, toward the top front of the roll; but, not over where the axle will be placed. Make sure it is behind the axle and, when looking from the front of the roll, all that should be seen is the narrow edge of the stick (not the thick side). Pictures are at the end of this lesson. Break the class into two-person teams.

Make The "Car"

Do not mention that the car will be powered by a rubber band propeller. Hand out all team materials except the propeller, rubber band and rubber band hook. Have students carefully write their initials on the roll, while warning them against flattening the roll. Explain to the class that we want to make a model car with the parts now in front of them. Ask them how each part might be used.

Ask one partner to push the popsicle stick through the cardboard all the way to the bottom (but not through) the roll. Make appropriate warnings about hot glue and hot glue guns. Only allow one team member at the hot glue guns at a time. At this point, allow the team member to come and glue the stick to the bottom of the roll and to the slit at the top of the roll.



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Show students how to center the axle and glue a bottle cap to the end of a dowel. Allow each member of the group to bring a dowel and a soda cap to the glue station. Allow them to glue one cap onto an axle. **Make sure they don't put the caps on both ends of the axle**. Allow one group member to put the axle through the toilet paper holder and return to the glue station in order to glue their second wheel onto the axle. Repeat this process with the other group member.

Whichever team member DID NOT put the popsicle stick onto the car should cut a notch (about 1/4 inch deep) on the back, center, top of the paper roll. Let them glue one end of the 6-in stick into the notch. Approximately 3/4ths inch of the stick should protrude beyond the notch in the back. Don't put glue on the part of the stick sticking out beyond the notch. The front of the stick should be glued to the side of the popsicle stick. The remainder of the stick should be protruding foward at enough of an angle to be approximately 3.5" to 4" above the ground. (See photos) Collect the cars.

End Day #1

It is unlikely that students will get beyond this point in the first day. Since Covid 19, students of this age have limit skills with hot glue. Thus, putting things together tends to take extra time. By limiting construction to three glue guns, this also limits how fast the project can be completed; however, it allows for better oversight and greater safety.

If you have extra time, ask the students how they think this car is going to be powered? Why is that stick at an angle? If they didn't get the axle in the middle of the soda cap, is that causing any problems? What materials do they have at home that could make a better car? (Ideas like using soda bottles instead of toilet paper tubes, etc.) Add any other questions you would like.

Day #2

Before class, use a hallway, or other large area, to measure and mark out, with blue masking tape, 5 feet, 10 feet, 15 feet, etc. until reaching 50 feet.

If students fell behind from Day #1, allow them to catch up before moving further. Give students the rubber-band hook. Have them put it onto the part of the six-inch stick protruding from the back. Make sure that the hook faces up. (DO NOT USE GLUE) Give the students the propeller and have them put it on the front of the six-inch stick. (DO NOT USE GLUE) Make sure that the metal "eye" is on the same side of the stick as the hook. If the hook or propeller is loose on the stick, add a little paper as a wedge between the stick and the plastic. Give the students the rubber band and have them connect it between the hook and the metal eye. In some cases, you may need to shorten the rubber band by tying an overhand knot.

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Have students turn their rubber bands (let them experiment with which direction) 50 times, put their car down on the "road," with the propeller facing forward, and test how far it goes. Assuming it went forward, have them reverse their turns on the propeller, place the car on the road so that the propeller is in the back and test again. Which went further?(This might be either direction depending on how well their axles and wheels were set.) Tell them to keep running their cars in whichever way worked best and measure how far the cars go when the rubber band is turned 75 times, 125 times, and 175 times.

Have them fill out the data sheet (attached).

Quick Physics: Discuss how the propeller and rubber band provided thrust to the racer. A spinning propeller moves air back and, according to Newton's Third Law of Motion: "For every action there is an equal and opposite reaction." Thus, the car moved the opposite way the air was being moved because the forces acting on it were no longer balanced. Placing ping-pong balls behind the racer at launch can help show the two forces in action. Also explain that as the students used energy (their finger) to wind the rubber band, much of that energy was being stored in the rubber band. We called this stored energy, "Potential Energy." The more times they turned the band, the more potential energy was in the rubber band. When they released the propeller, the potential energy was converted to kinetic energy (the energy of motion) as the propeller started moving. Once the rubber band had spent all of its stored energy, the propeller stopped spinning.

Ask students how they think they could improve their cars in order to make them go further with the same propeller and rubber-band system.

End Day 2

If you have extra time, allow the students to have a contest to see which car goes the furthest on 200 turns. Kids love a contest.

Kids can keep the car; however, you may need to flip a coin to decide which partner "wins".

Indiana Standards:

3-PS2-1: Plan and conduct an investigation to provide evidence of the effects of balanced and unbalanced forces on the motion of an object.

3-PS2-2: Make observations and/or measurements of an object's motion to provide evidence that a pattern can be used to predict future motion.

3-5-ETS1-1: Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.

3-5—ETS1-2: Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.

3-5-ETS1-3: Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.

4-H Project: Aerospace

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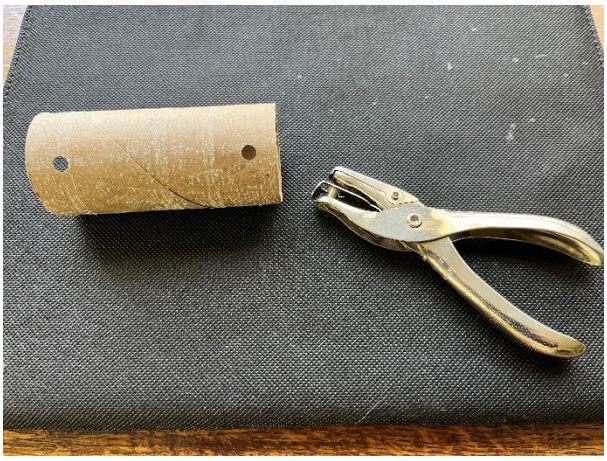
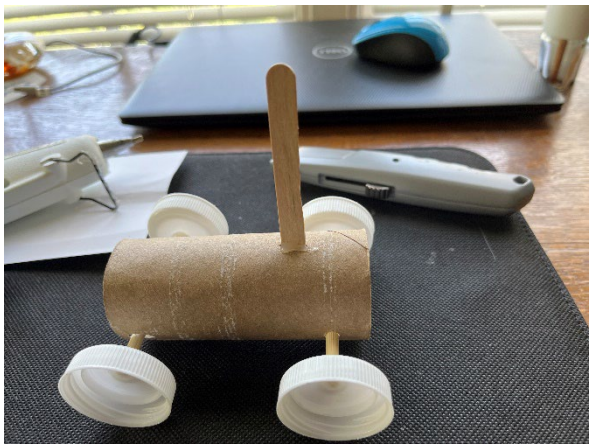
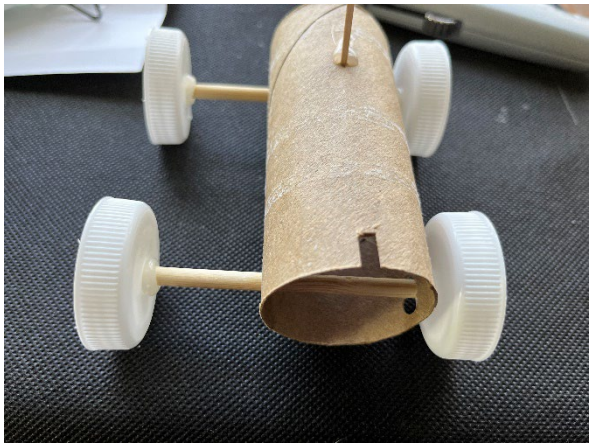
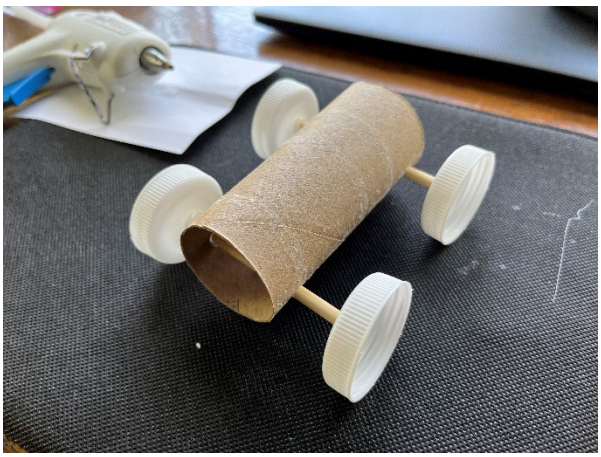
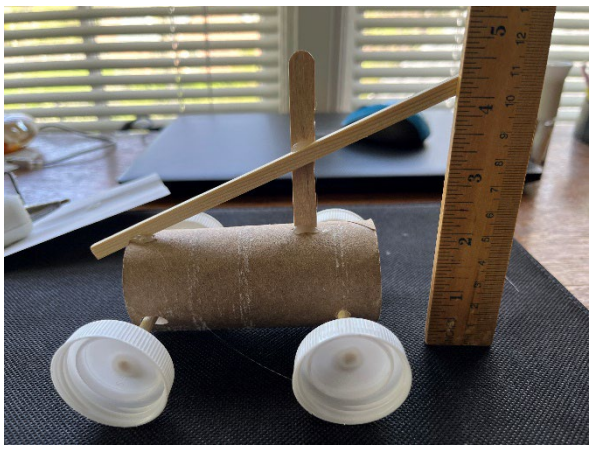
Basic Build Steps In Photos











Rubber Band Power Car Data Table	
Experiment	**How Far Did The Car Roll?**
50 Propeller Turns, Propeller In Front Of Car	
50 Propeller Turns, Propeller In Back Of Car	
75 Propeller Turns (Best Direction For Car)	
125 Propeller Turns (Best Direction For Car)	
175 Propeller Turns (Best Direction For Car)	