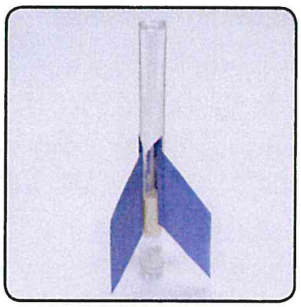
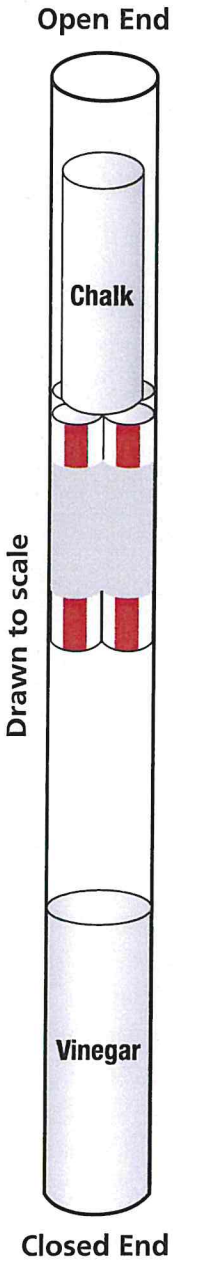
Engineer Physical Science Excitement

with a Carolina STEM Challenge®

Chemical Reaction Rockets

Workshop Activity





Materials

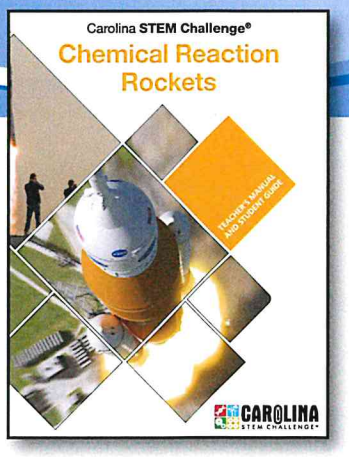
Tube, 1/2" diam
Clear Cap for Tube
Cotton Ball
Chalk
Vinegar
Straws
Tape
Construction Paper
Scissors
Pipette

Procedure

1. Put on gloves and safety goggles.
2. Cut 4 pieces of straw that are each 3 cm long.
3. Tape the 4 pieces of straw together into a bundle that will fit inside the tube and remain in place.
4. (Optional) Construct fins from construction paper and use tape to attach the fins to the rocket near the bottom of the rocket (open end).
5. (Optional) Attach a piece of cotton or a nose cone to the outside of the closed end of the rocket.
6. Hold the rocket with the open end up, and use a pipette to transfer 5 to 6 mL of vinegar into the rocket tube.
7. Place the bundle of straws into the tube.
8. Cut a piece of chalk approximately 2 cm long.
9. Place the piece of chalk inside the tube so that the chalk rests on top of the bundle of straws.
10. Place the cap on the open end of the tube.
11. Take the rocket to the launch station.
12. Invert the rocket so that the vinegar can react with the chalk.
13. Set the rocket, pointed upward, in the launch station and back away to a safe position.

Tips for safety

- Always wear appropriate PPE (personal protective equipment).
- Never point the rocket at another person.
- Use fins for stability.
- Use only the chemicals specified.
- This activity has been adjusted for an indoor launch. Make sure your launch site is safe for this activity. An outdoor launch site is recommended.
- If the rocket fails to launch, wait 5 minutes, then pick up the rocket with both ends facing away from you or any other person and pop the cap from the end using your thumb.
- Never make a design modification that weakens the strength of the tube or generates heat.
- Never glue or tape the cap to the rocket.



Carolina STEM Challenge®: Chemistry

Chemical Reaction Rockets

(catalog no. 820103)

Kit overview

In this exciting hands-on activity, students learn about factors affecting chemical reactions. During a warm-up activity, students build a rocket powered by a simple chemical reaction. That's right, the warm-up activity is building a rocket. Students make observations about how the design of the rocket and the chemical reaction work together to affect the altitude of the rocket after launch. Then students apply their critical-thinking skills to improve the design of the rocket.

During the design challenge, students brainstorm ways to improve their rockets that will result in higher altitudes and longer flight times. Students incorporate their knowledge of Newton's laws of motion, aerodynamics, chemistry, and reaction rates to solve a practical problem with specified parameters, which can be scored using the included Design Challenge Scoring Rubric. A Grading Rubric is also provided in the Teacher's Manual, facilitating assessment of each team's results. Team presentations allow students to reflect on their experience and demonstrate their mastery of the subject matter. Extension activities allow students to explore the science of rocketry further with recommended activities for reading and research. Technology extensions challenge students to incorporate the latest probeware and digital applications in their data collection and analysis process. Math extensions allow students to apply their skills in stoichiometry to chemical reactions, which provide thrust for the rocket. The kit materials support 15 teams.

Kit objectives

Students will:

- Observe gas-forming chemical reactions
- Engineer a rocket powered by a gas-producing chemical reaction
- Modify the reactants and the design of the rocket to maximize altitude

Kit materials

Included in the kit:
Chalk
Vinegar
½"-diam Tubes
¾"-diam Tubes
Caps for Tubes
Cotton Balls
Straws
Electrical Tape
Teacher's Manual and Student Guide

Needed but not supplied:
Plastic Containers (for launch site)
10-mL Graduated Cylinders
Transparent Tape
Masking Tape
Paper Towels
Scissors
Rulers
Metersticks
Timers
Inclinometer

Optional for the design challenge:
Baking Soda
Balance(s)
Plastic Wrap
Various Types of Tape
Construction Paper
Foam Board
Cardboard
Glue

Engineer Physical Science Excitement

with a Carolina STEM Challenge®

Balloon Race Cars

Workshop Activity

Materials

Building Instructions for the Balloon Race Car
Foam or Cardboard Tray
9" Balloon
3 Drinking Straws
2 Wooden Splints
Metric Ruler
Tape
Clay
Scissors
Sandpaper
Compass

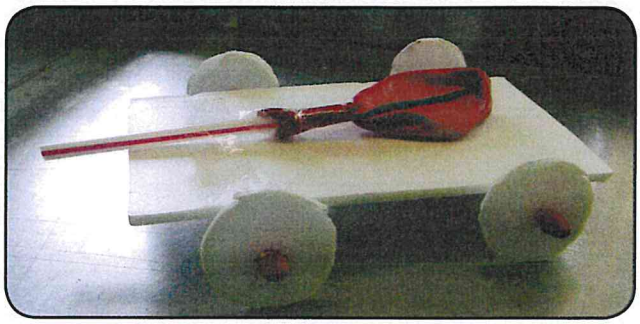


Figure 1: Foam car

Procedure

You have 30 minutes to complete this activity.

1. Find a partner.
2. Select material for the car (foam and/or cardboard).
3. Design and then cut out 1 body and 4 wheels.
4. Assemble car based on the Building Instructions for the Balloon Race Car. You can modify the design of your car as you see fit during building.
5. Conduct a trial run at the test track.
6. Record the distance traveled.

   Trial 1 _____ Trial 2 _____ Trial 3 _____
7. Make adjustments to your car, and repeat trial runs until time is called.
8. **Have fun!**

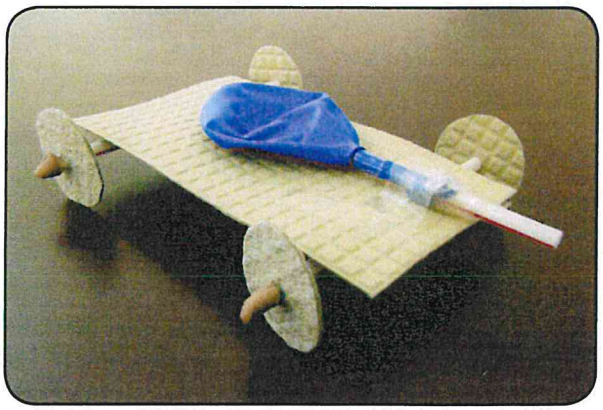


Figure 2: Cardboard car

Carolina STEM Challenge®: Physical Science

Balloon Race Cars

(catalog no. 750040)

Kit overview

In this series of hands-on activities, students learn about Newton's laws of motion by designing, building, and observing balloon-powered race cars. Students develop their engineering and critical-thinking skills by working in teams to find creative solutions to a design challenge presented to the class in a competitive format. First, students perform a Warm-Up Activity during which they assemble balloon-powered race cars out of a foam or cardboard tray, a balloon, and straws. Students measure the distance the balloon racers travel. During the Design Challenge, students brainstorm ways that the race car design can be modified to meet a specific challenge, such as traveling farthest or traveling fastest. They make modifications to the basic design, based on their knowledge of Newton's laws of motion, and then enter their engineered race cars into a classroom competition, which can be scored using the Design Challenge Scoring Rubric. A Grading Rubric also is provided in the Teacher's Manual, facilitating assessment of each team's results. Team presentations allow students the opportunity to reflect on their experience and demonstrate their learning in creative ways. Assessment questions and STEM-based extension activities are also included. This kit supports 15 teams of 2 or 3 students each.

Kit objectives

Students will:

- Examine applications of Newton's three laws of motion
- Build a balloon race car
- Draw force diagrams
- Design and build a balloon-powered race car, competing to build the race car that travels the fastest or farthest

Kit materials

Included in the kit:
30 9" Balloons
30 Foam Trays
100 Straws
250 Wooden Stirrers
32 5" Balloons
15 Cardboard Trays
4 Sheets of Sandpaper
1 lb of Modeling Clay
Teacher's Manual and Student Guide

Needed but not supplied:
15 Rolls of Tape
15 Scissors
15 Metric Rulers
5 or More Metersticks
15 or More Timers
15 Resealable Plastic Bags

Optional for the design challenge:
Other Objects to Construct Wheels
Other Objects to Construct Car Body
11" Balloons
Balloons of Other Shapes

Carolina STEM Challenge®:

Building Instructions

for the Balloon Race Car

To Create a Basic Balloon Race Car:

1. Design and then cut out 1 body and 4 wheels.
2. Create 2 wheel and axle systems (Figure 1).
3. Attach the wheel and axle systems to the car body with tape (Figure 2).
4. Attach a balloon to the straw (Figure 3). Wrap tape around the mouth of the balloon and ensure that no air escapes when the balloon is inflated. Designate 1 group member to blow up the balloon.
5. Attach the balloon/straw assembly to the top of the car with tape (Figure 4).

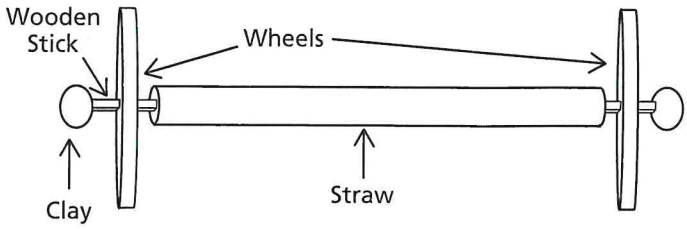


Figure 1: Wheel and Axle System

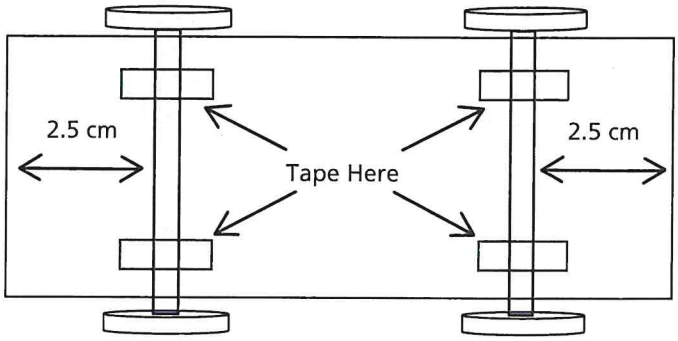


Figure 2: Axle Attachment to the Body

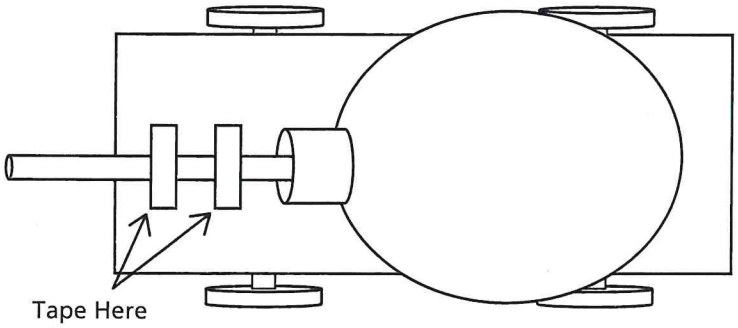


Figure 4: Balloon/Assembly Taped to the Race Car

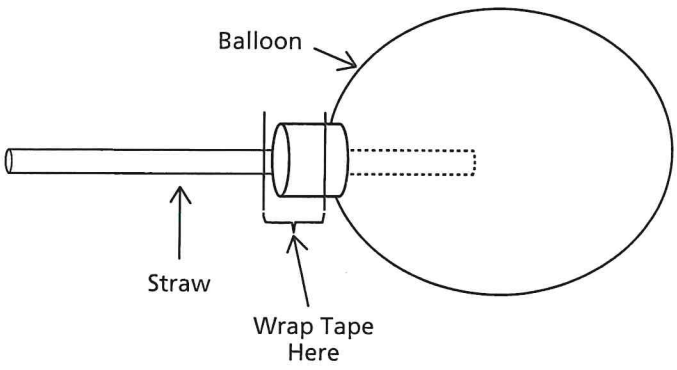


Figure 3: Balloon Attachment to the Straw

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Engineering and Design Vocabulary

Are you looking to incorporate more literacy into your science classroom?

Below is a list of words frequently used by engineers and designers. Encourage students to use these words when communicating with their project team, writing up reports, and presenting their findings.

Accuracy	**Analysis**	**Argument**	**Assessment**
Causation	**Claim**	**Communicate**	**Constraints**
Control	**Correlation**	**Criteria**	**Design (v.)**
Error	**Diagram (n.)**	**Effectiveness**	**Efficiency**
Function	**Evaluate**	**Evidence**	**Failure**
Inference	**Hypothesis**	**Impact (n.)**	**Implication**
Model	**Observation**	**Investigate**	**Limit**
Performance	**Plan (n.)**	**Parallax**	**Patterns**
Problem	**Process**	**Precision**	**Predict**
Quantitative	**Reasoning**	**Prototype**	**Qualitative**
Relevance	**Reliability**	**Refine**	**Reflect**
Requirements	**Scale**	**Repeatability**	**Reproducibility**
Test (v.)	**Theory**	**Simulation**	**Specifications (Specs)**
Uncertainty	**Variability**	**Trade-Off**	**Trueness**