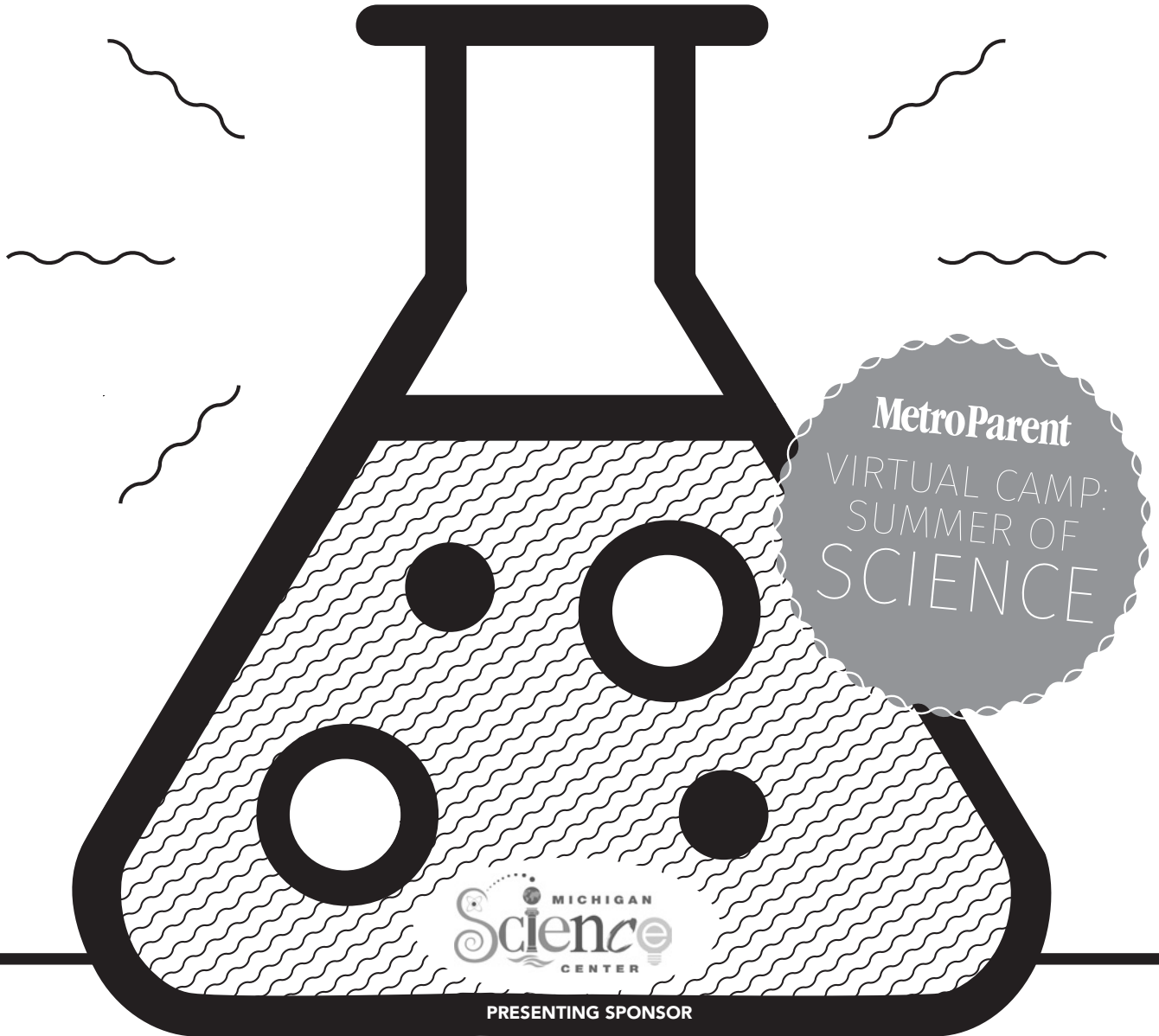
LESSON #5

IT'S ROCKET SCIENCE



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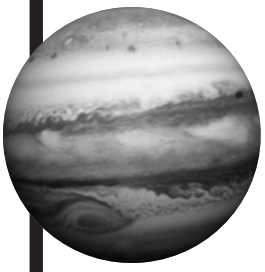
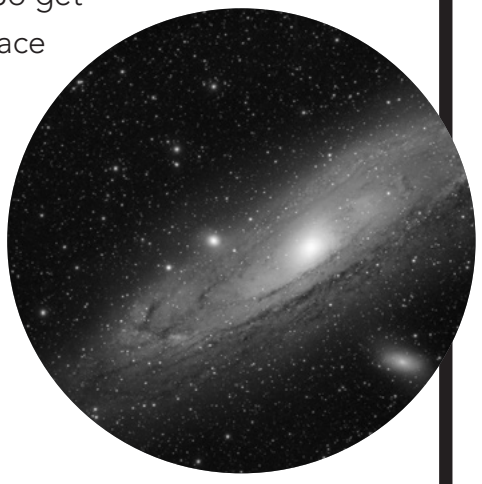
THE SKY'S THE LIMIT

WHEN IT COMES TO SCIENCE.



For ages, people have looked up and wondered, "What's out there?" And whether it's astronomy – the study of celestial objects like **stars**, **planets** and **galaxies** – or "rocket science" – spacecraft engineering – there's lots of physics, chemistry and other science involved!

Have you ever wondered how NASA landed people on the moon? Or what about the Mars exploration rovers, which are hunting for signs of past water activity on the red planet? Getting "out of this world" is a HUGE feat of science. It just takes a few household items to illustrate it, though! So get ready to blast off and learn with this special space manual – starting with a way-cool stomp rocket experiment.



STOMP ROCKETS

STUFF YOU'LL NEED

- 2 pieces of paper (8 1/2-by-11 inches)
- Scissors
- Tape
- Pencil
- 2 zip ties
- 2-liter beverage bottle, empty and clean/dry (cap not needed)
- 1-inch wide bike tire tube, new or used (about 2-3 feet long)
- 1-inch-wide PVC pipe (about 1 foot long)

THE CHALLENGE

How do spaceships and even airplanes get airborne?

It takes a lot of force, that's for sure. We can't build a real rocket, but we can explore the idea with paper.

THINGS TO EXPLORE FIRST

Air can be pretty "pushy." What happens when you blow into a bubble wand? Or if a big breeze catches a flag? What are some other ways air is powerful?

How can you create your own air? (Breaking wind doesn't count!) Could you do it with an empty plastic bottle?

Let's think about "projectiles." These are things you can throw or launch. What would travel farther if you threw it: a dart or a ball? Something long or something short? Maybe it depends on the shape, weight or size? What else?

SEE IT IN ACTION

Watch our puppet pal, Izzy, and her Michigan Science Center friends, David and Paulette, do the experiment!

SCIENTIFIC PROCEDURE

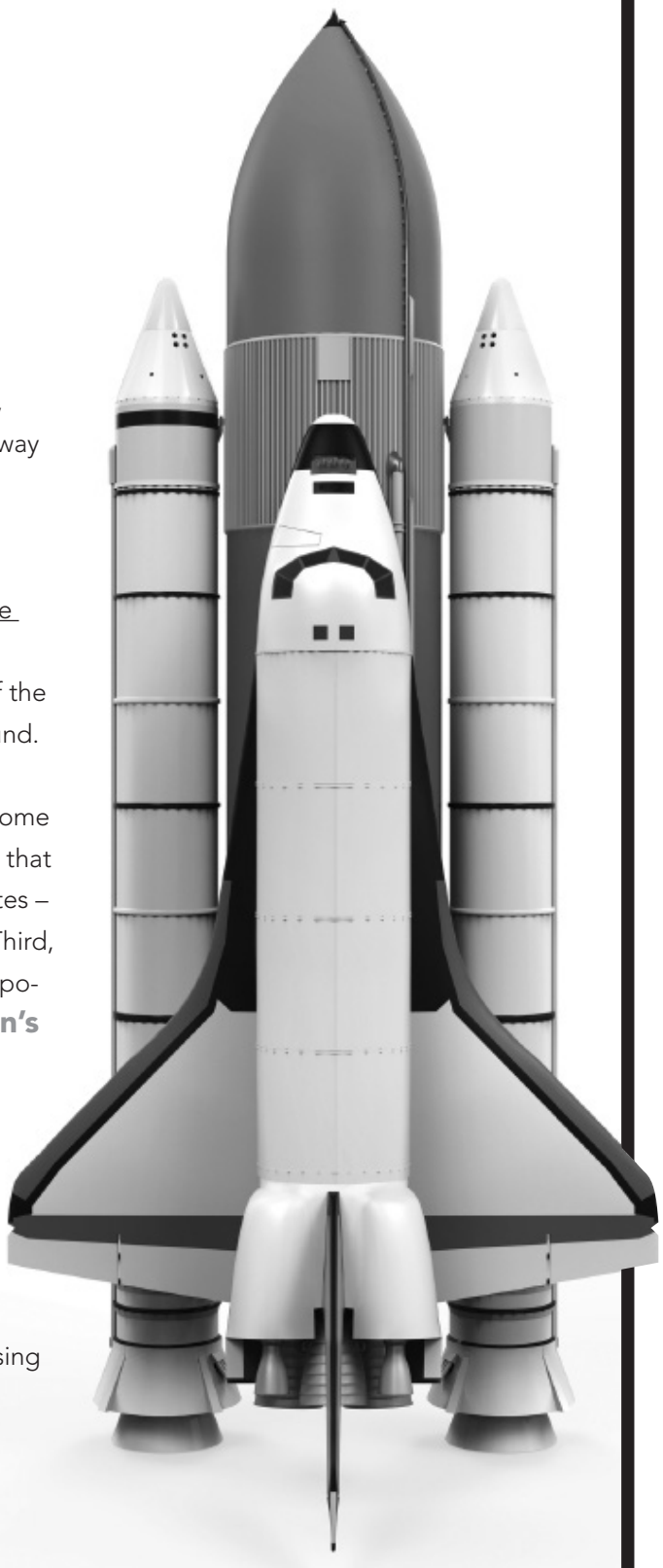
1. **Stretch one end of the bike tube** over the open mouth of the bottle so it's snugly fitted. Then, fit the other end of the tube over one side of the PVC pipe. Secure both connection points with zip ties.

2. **Wrap and roll one piece of paper** around the PVC pipe (avoid the tube part). Make sure it slips up and down the pipe easily, but not too loose. Once you've rolled up the paper all the way, secure the paper edges with tape. Remember, you're just taping the paper tube together – don't tape it onto the pipe.

3. **Now the rocket needs a seal.** You can either simply fold down the top of the tube a half inch and tape it down, sealing it off. Or, give it a proper cone. Cut a triangle from a second piece of paper. Roll it into a cone shape. Be sure the bottom of the cone is bigger than the hole of the paper tube. Once it looks good, tape the cone to hold its shape. Then, wedge the cone base onto the paper tube. Cut off any excess paper, and tape it in place securely to the paper tube. *Optional: Give your rocket fins, too! They're basically also triangles you can tape near the rocket's base.*

4. **Prepare for launch!** Slip the rocket onto the open end of the PVC pipe. Place the entire contraption on the ground. Have one person hold the PVC pipe – make sure to aim it up at the sky and away from other people, pets or breakables. It's definitely ideal to do this outside (safety first!). Finally, a second person stomps on the bottle and – whoosh – watch that paper rocket take off for outer space!

ROCKET *SCIENCE!*



Rockets need a lot of **force** to move. That's what you created by stomping on the bottle. You pushed the air into the tire tube and, next, the PVC pipe. Finally, it knocked the paper rocket out of its way – and way up!

A paper rocket like this is actually a **projectile**, which means it doesn't have its own energy source, notes the Community Science Workshop Network, and only moves when it's in contact with the launcher. It hits its fastest speed right when it blasts off the end of the PVC pipe. Then gravity slows it down, and it falls back to the ground.

So what about real rockets? NASA helps explain. First, they overcome gravity with *force* created by very **powerful engines**. Second, that *force* is equal to the mass (weight) of the gas and particles it creates – multiplied by the acceleration (speed rate) of those byproducts. Third, that blast of gas, smoke and flames "thrusts" the rocket in the opposite direction of the launch pad – up. These things tie to **Newton's three laws of motion**, the basics for all mechanics.

Also, the atmosphere creates **friction** or drag on a rocket. And, once the rocket escapes Earth's gravity, it slows down but must keep moving. Complex stuff!

Your paper projectile won't make it to the moon or Mars, but you can experiment with its speed and height. For instance, try using a bigger bottle or a shorter tire tube. What happens?

VENUS GREENHOUSE

Mercury is the closest planet to the sun. But its neighbor, Venus, is hotter – 864 degrees! (Mercury is 801.) Venus has a thicker atmosphere of carbon dioxide. The sun's heat gets in by day. At night, Venus tries to cool off by releasing infrared radiation – but it's trapped by thick clouds, notes the University of California.

Photo by NASA

TRIVIA TIME
DID YOU KNOW?

Ready to boost your intergalactic intelligence? Let's learn in 3, 2, 1 … go!

APOLLO TO ORION

Back in 1969, people first walked on the moon in NASA's Apollo 11 mission. The last time was 1972 on Apollo 17. Will people ever visit celestial bodies again? Yes. NASA is working on Orion, a spacecraft that will carry astronauts to an asteroid in the 2020s. Next stop in the 2030s? Mars!

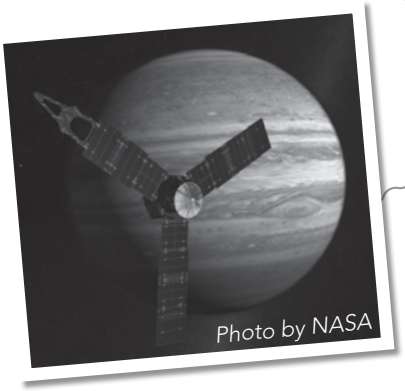


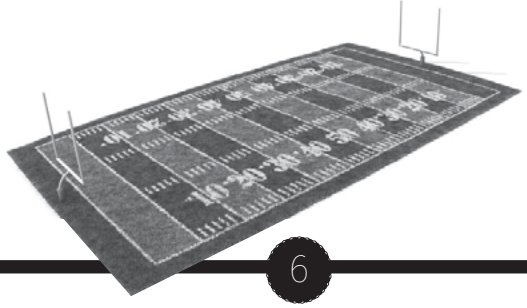
Photo by NASA

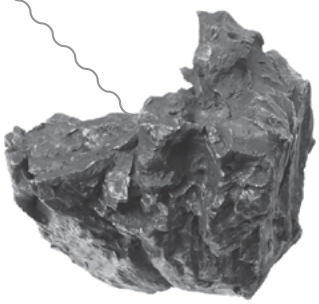
JUPITER JOURNEY

A NASA spacecraft called Juno just arrived at Jupiter in July 2016. It took five years to get there – and it was traveling 165,000 mph! Juno is solar-powered and will orbit Jupiter 37 times to study the planets atmosphere, NASA says. No people are on the mission, but there are three Lego figures on board.

HOME ON THE SPACESHIP

Did you know six astronauts live in space? The International Space Station orbits Earth about 220 miles away. It's as big as a football field, NASA says, with two bathrooms, a gym and a bay window! The U.S., Russia, Japan and Europe run labs in it.





SHOOTING 'STARS'

Those dazzling streaks of light are really small pieces of rock or dust, notes Cool Cosmos. Talk about projectiles: These pieces, aka meteors, fly so fast that once they hit Earth's atmosphere, they heat up and glow. If they're big enough, they may hit the ground – called a meteorite.

LEARN MORE
GREAT RESOURCES

SUGGESTED BY LOCAL TEACHER

Bridget Zahradnik, third grade teacher, Parkview Elementary, Novi and K-4 science content leader for Novi Community Schools

Get your brain around our vast solar system by tapping, flipping and playing.

TOYS & KITS

Little Labs: Stars and Planets Kit
Great for ages 5-plus, this kit By Thames & Kosmos lets kids construct their own solar system replica and constellations, create "moon craters," set off a rocket and more. Each experiment presents and answers a scientific question (like, "Why is there day and night?"). Comes with a 20-page guidebook.

Meteor Rocket Science Kit
This easy-to-assemble 17-inch rocket by Scientific Explorer soars 100 feet high, powered by a mix of baking soda and vinegar. For ages 9 and older.

Space Exploration Kit
Another cool Thames & Kosmos pick, this one lets kids ages 8-plus make a model of the solar system, launch three types of rockets, build a telescope and a star map and more. Contains 22 experiments.

WEBSITES

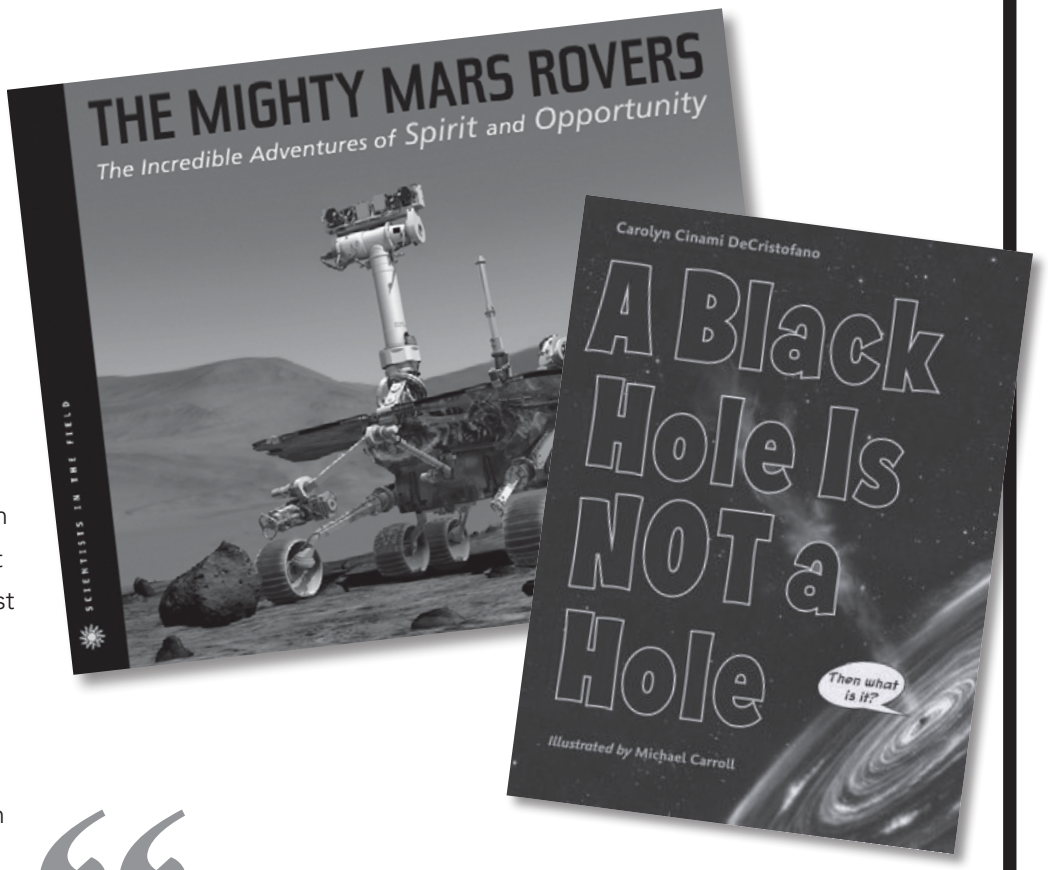
KidsAstronomy.com
Here, you'll get "extensive resources on all things astronomy, including games and "The Sky Tonight" – helping students identify various planets and constellations each night," Zahradnik says.

Space.com
Visit this hub for the most up-to-date news in space and astronomy, Zahradnik says. It's "great for older kids that are very interested in space and astronomy."

NASA Solar System Exploration
An interactive site that lets kids explore the solar system. Pick a planet to learn more about it (tip: find Pluto under "Dwarf Planets"), plus explore links to additional resources. Check out the NASA Kids' Club, too.

Space Exploration Kit

Meteor Rocket Science Kit



BOOKS

The Mighty Mars Rovers
By Elizabeth Rusch
Discover the amazing story of the Mars exploration rover space adventure through the eyes of Steven Squyres, professor of astronomy at Cornell University and lead scientist on the mission. Ages 10-12.

Is There Life on Other Planets?
By Gregory L. Vogt
Illustrations by Colin W. Thompson
This book for ages 9-plus investigates 17 statements about space and explains which are true, which aren't and which scientists still aren't sure about.

A Black Hole Is Not a Hole
By Carolyn Cinami DeCristofano
An engaging intro to black holes, ideal for kids ages 9-12. Readers learn what a black hole is, what causes them, how they were first discovered by scientists and how astronomers continue to find them.

"Learning about space is a great way to jumpstart kids' interest in science. It branches into so many different topics. We learn about greenhouse gasses and global climate change by studying Venus, nuclear physics by studying stars and what it takes for life to form by studying planets outside our solar system. There is so much about space that we don't know, and the next generation will help to unlock the many mysteries the universe has to offer."

– Paulette Auchtung, planetarium coordinator at Detroit's Michigan Science Center

SUGGESTED BY

Bridget Zahradnik

Who is she?
See page 7.

FIELD TRIP
GO EXPLORE

Ready to get way out of this world? These local spots have planetariums and more.

Michigan Science Center
5020 John R St., Detroit
313-577-8400, mi-sci.org

First blast off to the Space gallery, featuring real rocket models like an Apollo training capsule and a heliostat that gives up-close views of the sun. And of course, don't miss the Dassault Systèmes Planetarium with its Digistar II projection system, 13,000-watt surround-sound system and 50-foot-wide, three-story-high dome. Check ahead for the current shows.

Astronomy at the Beach
Sept. 9-10, 2016
Maple Beach at Kensington Metropark
4570 Huron River Parkway, Milford
glaac.org

The first weekend after school starts, head to this 20th annual event that goes 6 p.m.-midnight both days. Peer through telescopes, see a "comet" made from dry ice and other stuff, become a constellation in a kids play and loads more. It's a big, fun event held by the Great Lakes Association of Astronomy Club.

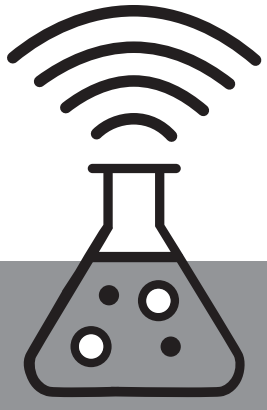
Michigan Science Center

Cranbrook Institute of Science

University of Michigan Museum of Natural History

Cranbrook Institute of Science
39221 Woodward Ave.,
Bloomfield Hills
248-645-3200,
science.cranbrook.edu
Find "excellent programs for all ages," Zahradnik says. Its planetarium features a state-of-the-art Digistar star projector and 360-degree experience. Programs run daily during the summer and year-round at select times Fridays-Sundays the rest of the year. Learn more with Cranbrook's online astronomy resources.

University of Michigan Museum of Natural History
1109 Geddes Ave., Ann Arbor
734-764-0480, ummnh.org
At just $5 a person, the daily planetarium shows here help kids delve deeper into space. *Larry Cat, In Space* in particular mixes up cartoons and science as a feline sneaks on board a shuttle to look for his human, Diana (it's 12:30 pm. Mondays-Fridays). Other shows rotate, offering views of the night sky, telescopes and more.



TEST YOUR SMARTS

Don't chew that No. 2! This quick quiz is just a few questions about what kids learned after trying the experiment and using this guide to learn more – done in a few clicks. So put on that thinking cap.