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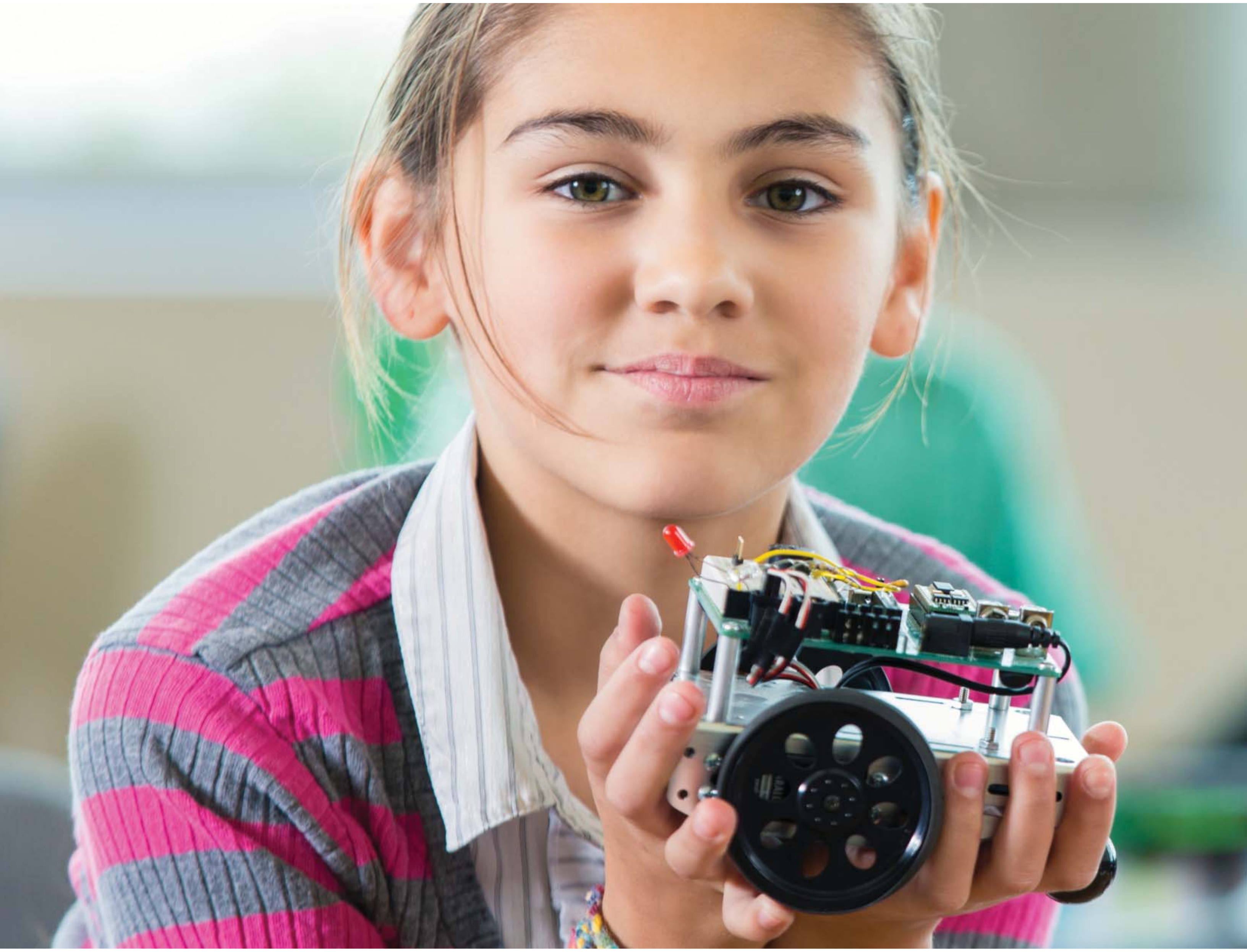

idea packet

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STEM made SIMPLE

STEM made SIMPLE
(Sensible, Integrated, Meaningful, Purposeful Learning & Engaging!)

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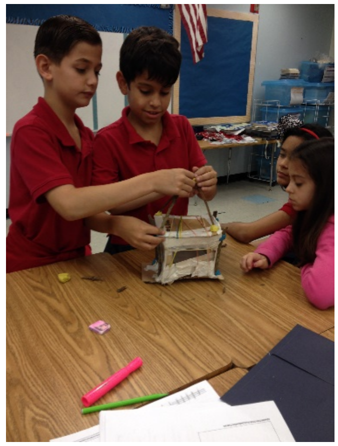

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Goals and Objectives

GRADE ONE
Science/Big Idea 12: Motion of Objects
SC.1.P.12.1 Demonstrate and describe the various ways that objects can move, such as in a straight line, zigzag, back-and-forth, round-and-round, fast, slow
Big Idea 13: Forces and Changes in Motion
SC.1.P.13.1 Demonstrate the way to change an object is by applying a push or a pull
GRADE TWO
Science/Big Idea 1: The Practice of Science
SC.2.N.1.1 Raise questions about the natural world, investigate them in teams through free exploration and systematic observations, and generate appropriate explanations based on those explorations
SC.2.N.1.2 Compare the observations made by different groups using the same tools
Big Idea 13: Forces and Changes in Motion
SC.2.P.13.1 Investigate the effect of applying various pushes and pulls on different objects
SC.2.P.13.4 Demonstrate that the greater the force (push or pull) applied to an object, the greater the change in motion of the object.

GRADE THREE
Science/Big Idea 1: The Practice of Science
SC.3.N.1.1 Raise questions about the natural world, investigate them individually and in teams through free exploration and systematic investigations, and generate appropriate explanations based on those explorations.
SC.3.N.1.2 Compare the observations made by different groups using the same tools and seek reasons to explain the differences across groups.
SC.3.N.1.5 Recognize that scientists question, discuss, and check each other's' evidence and explanations.
Big Idea 2: The Role of Theories, Laws, Hypotheses, and Models
SC.3.N.3.2 Recognize that scientists use models to help understand and explain how things work.
SC.3.N.3.3 Recognize that all models approximate natural phenomena; as such, they do not perfectly account for all observations.

GRADE FOUR
Science/Big Idea 1: The Practice of Science
SC.4.N.1.1 Raise questions about the natural world, use appropriate reference materials that support understanding to obtain information (identifying the source), conduct both individual and team investigations through free exploration and systematic investigations, and generate appropriate explanations based on those explorations.
SC.4.N.1.3 Explain that science does not always follow a rigidly defined method but that science does involve the use of observations and empirical evidence. ("the scientific method").
SC.4.N.1.5 Compare the methods and results of investigations done by other classmates.
SC.4.N.1.8 Recognize that science involves creativity in designing experiments.

Big Idea 3: The Role of Theories, Laws, Hypotheses, and Models
SC.4.N.3.1 Explain that models can be three dimensional, two dimensional, an explanation in your mind, or a computer model.

GRADE FIVE
Science/Big Idea 1: The Practice of Science
SC.5.N.1.1 Define a problem, use appropriate reference materials to support scientific understanding, plan and carry out scientific investigations of various types such as: systematic observations, experiments requiring the identification of variables, collecting and organizing data, interpreting data in charts, tables, and graphics, analyze information, make predictions, and defend conclusions.
SC.5.N.1.3 Recognize and explain the need for repeated experimental trials.
SC.5.N.1.5 Recognize and explain that authentic scientific investigation frequently does not parallel the steps of "the scientific method".
Big Idea 2: The Characteristics of Scientific Knowledge
SC.5.N.2.1 Recognize and explain that science is grounded in empirical observations that are testable; explanation must always be linked with evidence.
SC.5.N.2.2 Recognize and explain that when scientific investigations are carried out, the evidence produced by those investigations should be replicable by others.

GRADE SIX
Science/Big Idea 1: The Practice of Science
SC.6.N.1.4 Discuss, compare, and negotiate methods used, results obtained, and explanations among groups of students conducting the same investigation.
SC.6.N.1.5 Recognize that science involves creativity, not just in designing experiments, but also in creating explanations that fit evidence.
Big Idea 2: The Characteristics of Scientific Knowledge
SC.6.N.2.2 Explain that scientific knowledge is durable because it is open to change as new evidence or interpretations are encountered.

8 Practices in the Next Gen Science and Engineering Standards

1. Asking questions (science) and defining problems (for engineering)
2. Developing and use models
3. Planning and carrying out investigations
4. Analyzing and interpreting data
5. Using mathematics and computational thinking
6. Constructing explanations (science) and designing solutions (engineering)
7. Engaging in argument from evidence
8. Obtaining, evaluating, and communicating information

Course Outline and Overview

Afraid to teach Science or STEM in the Classroom? Looking for ways that you and your students will find STEM enjoyable and fun, and at the same time ensure that important concepts are being taught and learning is taking place? Starting off with something SIMPLE (Sensible, Integrated, Meaningful, Purposeful Learning & Engaging)such as making a paper helicopter, a windmill, parachutes, a lunar lander and a catapult can be expanded to cover concepts students need to learn under the umbrella of Physical Science, Earth and Space, Science and Technology, Engineering and, believe it or not, Social Studies. The purpose of this project is to change the perception that both teachers and students have alike regarding Science, in particular STEM, and using these hands-on activities to go further resulting in project/problem based learning. For example, the first step in the "windmill project" is to introduce students to the concept of wind energy by making a paper windmill. As students learn more about wind energy as a renewable resource, they begin researching how wind energy is used in electricity, water conservation, and as a "future" resource in transportation vehicles by designing and creating a "wind-powered" car. They learn how wind energy was an "idea" and how that "idea" became a reality used today in many remote areas where electricity and clean water seemed impossible to obtain. Within the scope of the lessons, students are learning the importance of research, design, problem-solving, creating, sharing, inquiry, Reading, Writing, using Math skills, the history of discoveries, while having fun!

Resources

The resources listed below will serve as a guide to finding the activities and other lessons that can be integrated in your lesson planning and instruction. There are so many resources available to teachers, but the reality is we may not have the time to find them all. At the same time, some resources may not "fit" the concepts we need our students to learn and know in assisting them with testing, though our goal should be to encourage both our boys and girls in learning and loving Science by connecting it within all our subjects. With all of this in mind, I hope those listed below will help you on your first step in teaching STEM in the classroom and keeping it SIMPLE!

STEM

**Sally Ride EarthKAM website (great resource for students, and they are starting a new mission soon in November)

www.stem-works.com

www.girlstart.org

http://stemfriday.wordpress.com

http://imaginationsoup.net

http://simaero.rti.org

www.tryengineering.org

www.girlsrisenet.org

www.childrens.engineering.com

http://scigirlsconnect.org

http://pbskids.org/designsquad/

www.nasa.gov/audience/foreducators/best/

www.tryengineering.org

www.engineeringsights.org

http://stem.firstbook.org

www.stemnet.org

www.stemfinity.com

http://newtonstem.org

www.mos.org/eie

www.stemforkids.net

www.istemnetwork.org

http://stemcollaborative.org

http://kidsactivitiesblog.com/53474/giant-paper-pinwheels

https://youtu.be/gCSZQf2r6QE video for the boy who harnessed the wind

Literature and Math Connection:

The Boy Who Harnessed the Wind by William Kamkwamba *Elementary (there is older a version that is better suited to middle and high school students)

Engineering For Every Kid: Easy Activities That Make Science Fun! by Janice VanCleave

Tinkering: Kids Learn by Making Stuff by Curt Gabrielson

Amazing Leonardo da Vinci Inventions: You Can Build Yourself (Build It Yourself) by Maxine Anderson (Can be used with Helicopter Activity)

Make: Paper Inventions: Machines that Move, Drawings that Light Up, and Wearables and Structures You Can Cut, Fold, and Roll by Kathy Ceceri

Kids Paper Airplane Book! by Ken Blackburn

Built to Last by David MaCaulay

Imaginative Inventions by Charise Mericle Harper

Articles

Micro Wind Turbines Could Be Huge Deal for Ford (November 13th, 2014) by Tina Casey

Vehicles that Run by Solar and Wind Energy by Hsinchu News Group, Formosa (Originally in English)

Wind-Powered Land Vehicle – from Wikipedia (free encyclopedia)

Lesson Plans/Handouts

The following lessons and activities serve as a guide to introducing and implementing the Science concepts to your students. They are a good way to introduce the engineering process or they can also be used as a STEM/STEAM activity helping students understand how scientists work, the practice of science, the nature of inquiry and the Scientific Method.

Wind as a Source of Energy STEM Lab Teacher Guide

Benchmarks:
SC.4.P.10.4 Describe how moving water and air are sources of energy and can be used to move use.
SC.4.N.1.1 Raise questions about the natural world, investigate them in teams through free explorations, and generate appropriate explanations based on those explorations.

Materials: Ahead of time collect these or similar materials for students to use to make pinwheels: **(initial lesson)** windmill template**,** pin, pencil, scissors, (optional materials for revisit) tape, straw, Popsicle sticks, paper, clay, pins, paper fasteners.

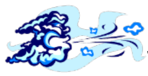
Engage: Ask students how can wind energy (air) be a source of energy that makes things move? Open Discovery Education on teacher portal. Play the following Discovery Education hyperlinked video clip: **Wind Energy** . Discuss.

Explore: Students will use any of the available materials to design and build a pinwheel. Students will list materials used and procedures followed.

Sample Pinwheel Procedures:

1. Cut a piece of cardstock into a 4' square. (If you're only doing this part of the project, you can make it bigger if you like.) Look at the **pinwheel pattern** to do the following steps.
2. Use a ruler to draw diagonal lines from corner to corner. Make a small mark along each line 3/4 of an inch from the center of the square.
3. Cut along the diagonal lines toward the center until you reach the 3/4-inch mark.
4. Fold the corners marked with circles on the pattern into the center and staple the layers together. (You'll probably need to use at least two staples, but make sure to leave space between staples in the very center). When all four 'blades' are folded in, stick a straight pin or thumbtack through all the layers at the center. Push the pin through the eraser on the pencil to finish the pinwheel.
5. Hold the pinwheel in front of a fan and watch it spin. The currents of air coming from the fan catch the curved part of the blades, causing them to spin.

Name ______________________________ Date _______________



Wind as a Source of Energy STEM Lab Student

SC.4.P.10.4 Describe how moving water and air are sources of energy and can be used to move use.

Materials Available: (initial lesson) windmill template**,** pin, pencil, scissors, (optional materials for revisit) tape, straw, Popsicle sticks, paper, clay, pins, paper fasteners.

Inquiry: Use any of the available materials to design and build a pinwheel.

Pinwheel Materials Used:

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Pinwheel Procedures:

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Conclusion:

1. Write to explain how wind turns your pinwheel.

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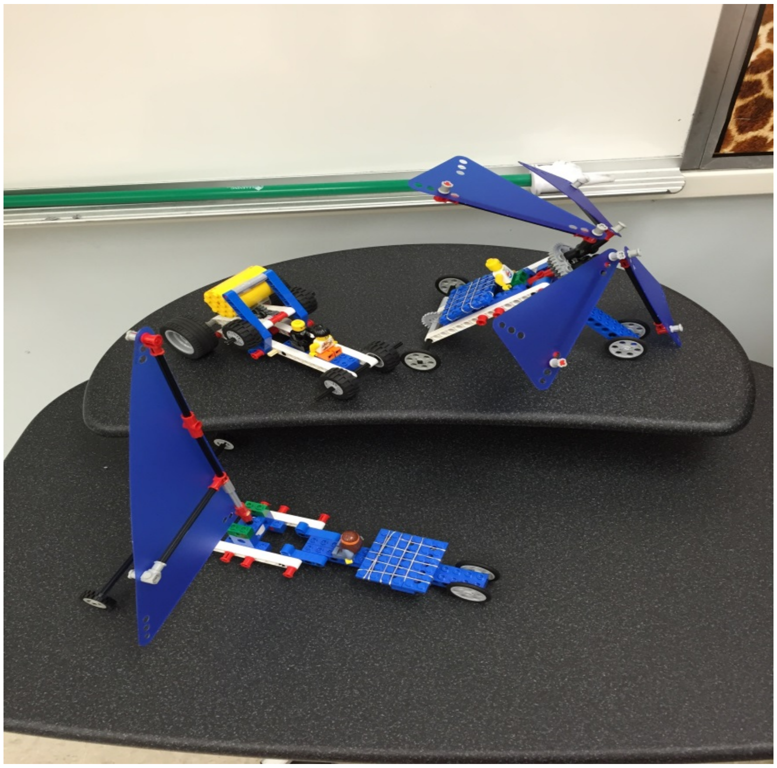
2. List four things that wind is useful for.

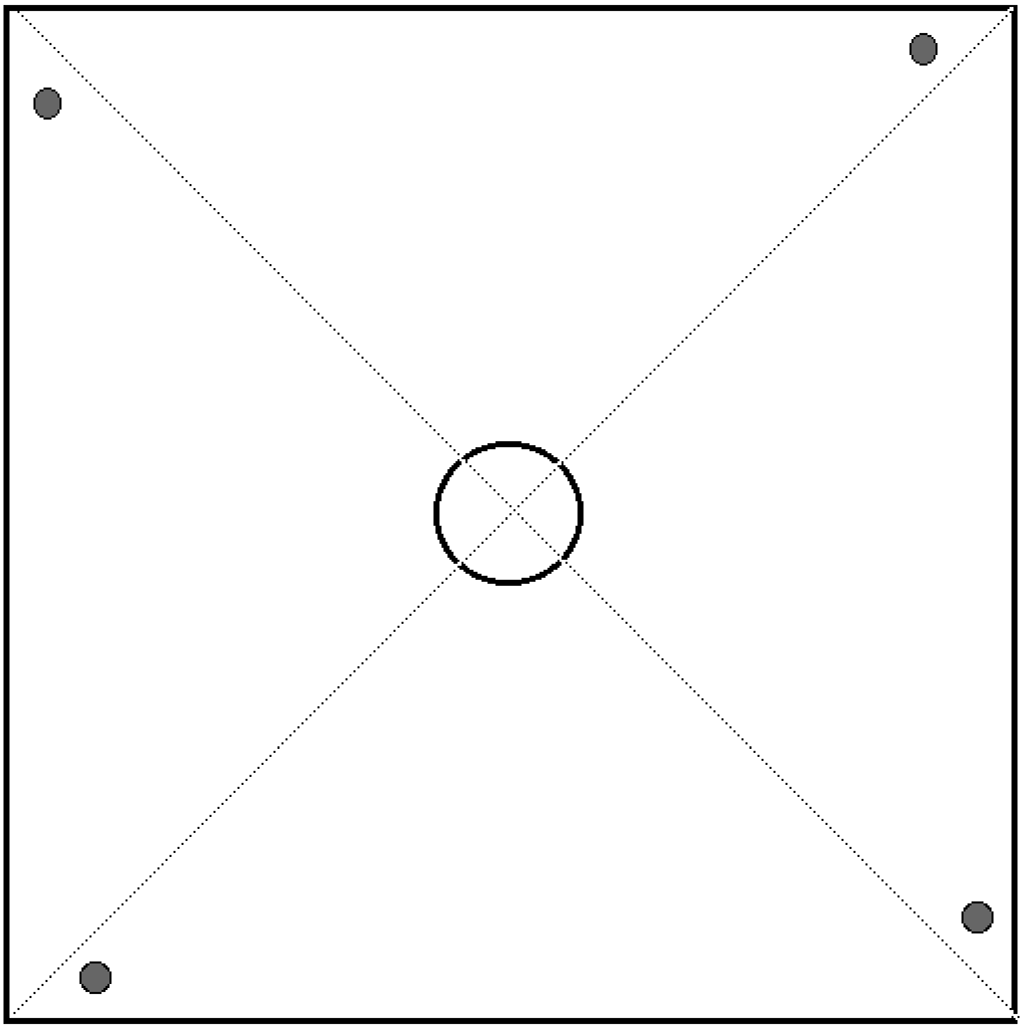
Real World Connection:

3. What are examples of people using air to make things move?

4. How can we use wind to our advantage?



Pinwheel Pattern



Parachute Lesson Plan

Engage: Introduce students to the lesson by brainstorming and creating a concept map on the board with what they know about parachutes. List everything the students mention, paying close attention to vocabulary that may signify their understanding of such science/engineering concepts as air resistance, gravity, mass, weight, speed, distance, landing, design, trials…have them list these in their journals. Then have them talk about what materials would be used in "real-life" and why. Again, have them list these items in their journals. Once this is completed, read the story "How Parachutes Work" by Jennifer Boothroyd or something similar to introduce the lesson. You can also explore Da Vinci and his designs for older students (*See "I Wonder" at end of lessons*).

Explore: Students will now be ready to come up with a design. Have them design and illustrate their parachute in their journals. Explain that certain materials will be available for their use, but will be limited in quantity. (*This will help them understand how engineers have to work with certain materials and may have to improvise and revisit their design. This also introduces them to the making of a prototype and/or model which can be further explored in another lesson down the road*). Provide students with materials (see material list) and have them put together their parachute to take outside in an area where they will "let it go". Certain shapes can be provided, but give students the opportunity to come up with their own size and shape.

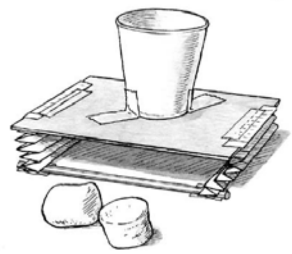
Explain: During this part of the lesson, explain your expectations and guidelines with the students. Discuss the importance of working with their partner/s respectfully and as a team. Remind them that everyone will "drop" their parachute at the same time. Further explore distance and landing and explain that they can measure the speed of their parachute's "fall" by using tools that scientists use such as a stopwatch. (*Though it can be further explored and elaborated in another lesson, do not discuss* ***variables*** *yet…let them discover what changes can be made when they "revisit" and "re-design" their parachute in another lesson (i.e. adding more weight, or changing the paper/bag*).

Elaborate: Have students complete their parachutes and take them to an area where they will be able to "drop" their parachutes and still be able to time the "fall" and record results in their journals. Students should be able to repeat the "fall" at least 3 times to have sufficient data for graphing. Once everyone has had a chance to "drop" their parachute 3 times, have them write their observations in their journals, including what they felt "worked" and "didn't work". They should also write down what things they would change (design, material…), how they would change them, and what difference they believe it would make to ensure their parachute "lands safely" and in a timely manner. This may take time. Give the students time to reflect and compare their designs with other teams.

Evaluate: As a way of evaluating student's work in these types of projects, I believe a rubric is a good tool to use to evaluate student's work and progress. I have created a rubric to go with some lessons (see PBL Rubric page) that can be adapted and changed as it fits your student's needs. I include teamwork, team effort, journal work, writing, design, articles/reading passages completed, graphing (Math) and vocabulary as part of their evaluation and/or grades.

Further Exploration: Students should be given an opportunity to further explore their designs and parachute model in a culminating activity during a STEM day or on their own during a center activity, (*of course, they need to be supervised if they go outside, but it is possible they can let their parachute "fall" if they stand safely on their chair*). This can also be revisited during a lesson on Newton's laws of motion, the practice of Science, a STEM classroom activity…They will also be better equipped in the process of designing, problem-solving, reassessing their model when they participate in making their "lunar lander". (See Lunar Lander lesson)

Adapted from www.sciencekids.co.nz/experiments.html



Lunar Lander Lesson

Engage: Have students watch the Curiosity Rover video (I added link to Resource page) as an introduction, then pose the question, "What would happen if astronauts had to land on the Moon? How can engineers design a "lander" that will ensure they land safely on the Moon? Brainstorm ideas with students and have them make a list of possible outcomes and challenges.

Explore: Students can begin to explore making their design "challenge" using the directions below and using the materials to put together their lunar lander. This can be completed in class, in teams, or I have also implemented it during our Science/STEM night at a station.

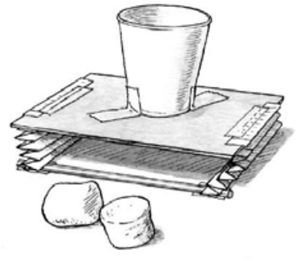
The Challenge

Explanation and Further Exploration:

"NASA is looking for safe landing sites on the moon. Once they find one, they need to design and build a spacecraft that can land there without injuring astronauts or damaging the spacecraft. Today you'll make a lander—a spacecraft that can land safely when you drop it on the floor. As you test it, you'll find ways to make it work better. Improving a design based on testing is called the engineering design process."

Design and build a shock-absorbing system that will protect two "astronauts" when they land. In this challenge, kids follow the engineering design process to: (1) design and build a shock-absorbing system out of paper, straws, and mini-marshmallows; (2) attach their shock absorber to a cardboard platform; and (3) improve their design based on testing results.

Materials: (paper cup) astronauts (marshmallows) spring (folded index card) platform (cardboard) tape (see sample picture above and below)



Test, Evaluate & Redesign: During this phase, students should "test" their design. Students will observe whether the marshmallows (astronauts) stay in their "seat" (small cup) or whether they fall out.

After testing their model, students should revisit their design, recording their observations and any changes they will make to ensure the safe landing of the astronauts by revising the "shock absorber" and spacecraft. Teachers can use a rubric for the evaluation, or also observations. For further evaluation, teachers can "grade" the finished product, and the success of the landing.

Explain: Have students drop their lander from a height of one foot (30 cm). If the "astronauts" bounce out, have them brainstorm ways to improve their design. Revise any problems and redesign. If their spacecraft tips over as it falls through the air (gravity)—tell the students to make sure it's level when they release it. Use masking tape to keep the cup centered on the cardboard. Check the "astronauts" in the cup and make any changes necessary so when they land, they will not "bounce" out.

Extension: After revisiting their design and revising any "problems", have students repeat the "drop". For future exploration, students can increase the height they will drop their lander. They can also change the amount of "astronauts" in their cup.

<u>Helicopter and Catapult Activity</u>

Both of these activities can be modified for all grade levels. Special consideration should be taken when working with the catapult to ensure the safety of students in primary grades. Throughout the school year, I ask both students and teachers to donate soda or water bottle caps of all sizes. I save them for future projects (other STEM projects we do throughout the year), but they are great for the catapults. The helicopters can be made from simple copy paper, but to add creativity (ART), students can decorate them, color them or use "color" copy paper. They are simple to make. (See directions on next page).

Directions for students for Helicopter Activity

1. Use the template on the next page as your guide when you are cutting your helicopter.

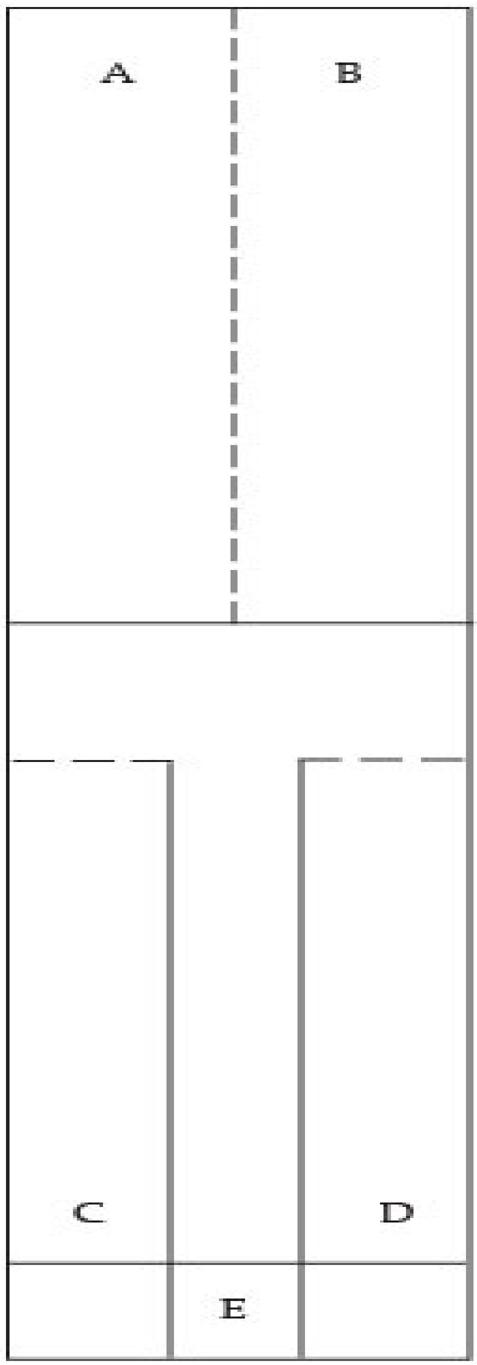
2. Cut 1.75” off the bottom of a sheet of paper. This will give you a long, skinny rectangle. The next cut to make is along the dashed line that is between the letters A and B. After that, make two small cuts directly above the letters C and D.

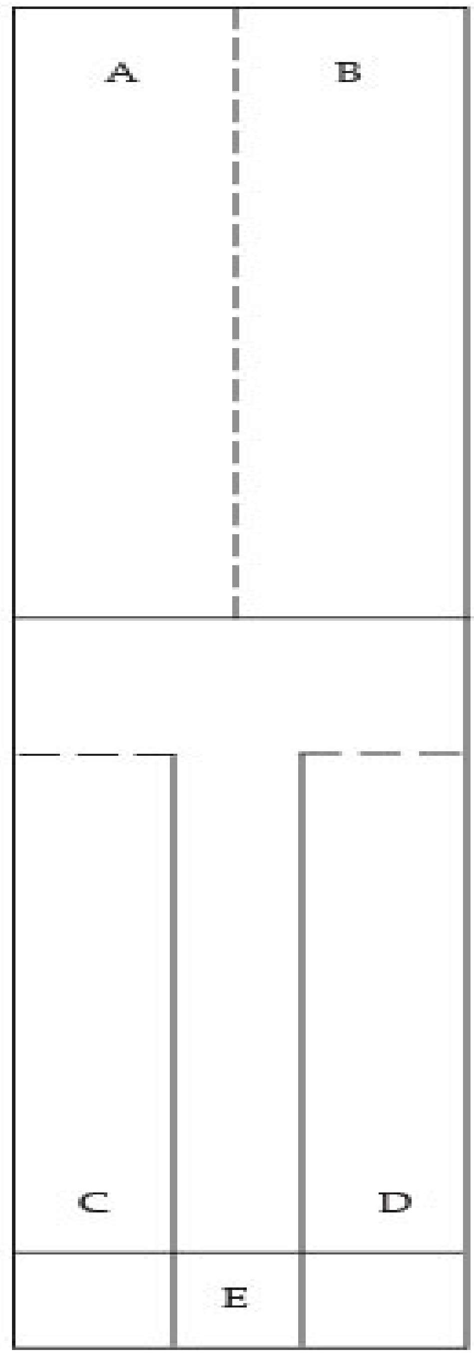
3. Once you’ve made your cuts, fold one of the long strips (A) to the back, crease it along the solid line, and fold the other strip (B) toward the front. These are the rotors of the helicopter.   It should look like a giant capital I with bunny ears.

4. Fold the sides (C & D) into the middle, just as you would fold a legal letter. This is the body of the helicopter.

5. The last thing to do is to fold the bottom (E) up about half an inch. This fold helps keep everything together.

6. Assume the helicopter flying position: Stand on a chair, extend your arm with the helicopter in the air gently lifting it up in the air and letting go. Watch as it “twirls” to the ground.


A
B
C
D
E


A
B
C
D
E

Directions and Materials for Catapults

Making a catapult can be a fun lesson. Students can research how this contraption was used to "move" objects in the Middle Ages.

Materials: 7 craft sticks, 3 rubber bands, and a milk cap

1. Stack 5 craft sticks together, and rubber band the ends.
2. Stack 2 craft sticks together, and wrap a rubber band around the very end.
3. Separate the 2 craft sticks. Place the stack of 5 craft sticks between the 2 craft sticks.
4. Wrap a rubber band around all of the craft sticks to hold the catapult together.
5. Glue a milk cap {or something similar} on to serve as a launching platform.
6. Push down on the top craft stick and release to launch an object from the milk cap.

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For more information, contact:

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