Kindergarten STEM Design Challenge
CORRESPONDING ENGINEERING DESIGN PROCESS STAGE IN RED

Unit 4: Exploring Energy
Subject/ grade level: STEM/ Kindergarten
Topic: Design a Kaleidoscope

Materials:
Suggested for teams of 2-3 students unless indicated otherwise

For the "Research the Problem" Section

- Fabric softener sheet
- Clear tape
- Clear, glass candle holder
- Tissue paper, tag board, cellophane (2 colors), and construction paper

Design 1

- Pringles can
- Decorative contact paper, construction paper and glue, or paints
- Colored tissue paper
- White glue
- Foam brush
- Hammer and large nail
- Clear plastic

Design 2

- Paper towel tube cut eight inches (20 centimeters) long
- Clear plastic report cover
- Ruler and Pen (or marker)
- Four-inch squares (one each) of black construction paper, plastic wrap, and waxed paper
- Scissors
- Rubber band
- Stickers and wrapping paper

For Both Designs

- Opaque, transparent, and translucent items to put in kaleidoscopes
- 21st Century Skill rubric for grading project
- Websites
    - http://www.brainpopjr.com/science/energy/light/
    - http://www.permadi.com/java/spaint/spaint.html
    - http://thechocolatemuffintree.blogspot.com/2011/06/so-easy-kaleidoscope.html
    - http://kids.nationalgeographic.com/kids/activities/funscience/be-dazzled/

TEKS

Science

SCI K.5A Observe and record properties of objects, including relative size and mass, such as bigger or smaller, and heavier and lighter, shape, color, and texture.

*SCI.K.6A Use the five senses to explore different forms of energy such as light, heat, and sound.

Math

MA K.8.A. Collect, sort, and organize data into two or three categories.

ELPS
C1E Internalize new basic and academic language by using and reusing it in meaningful ways in speaking and writing activities that build concept and language attainment.
C3E Share information in cooperative learning interactions.

CCRS
Science
1C1A Work in teams and share responsibilities, acknowledging, encouraging, and valuing contributions of all.
1E2A Define and use a basic set of technical terms correctly and in context for each discipline studied.

Math
6B4A Describe any natural variability evident in the results within the context of the situation.

Cross-disciplinary
1E1B Follow directions or procedures independently.
2E1B Use devices to measure physical properties.

Lesson objective(s):
Students will observe light using their sense of sight as it passes through different materials by designing and making a kaleidoscope. Students will learn that the amount of light passing through an object depends on if it is made of transparent, translucent, and opaque materials.

Differentiation strategies to meet diverse learner needs:
In all of the stages, the teacher may consider

- Implementing flexible groups, such as mixed-ability or pairs, during the engineering design process activities.
- Adjusting the pacing (break into smaller units) and/or scaffold activities for students as necessary.
- Provide several opportunities for students to repeat and explain directions.

The teacher will show students 3 items (a piece of wrapping paper, a glass candle holder, and a fabric softener sheet). The teacher will have students share how those items are different. Students can examine how the wrapping paper does not allow light to pass through, the clear glass candle holder allows most light to pass through, and the fabric softener sheet allows some light to pass through. The teacher will have students brainstorm other items that could be translucent, transparent, or opaque.

Next, the teacher will have students name the three items (wrapping paper, candle holder, and fabric softener sheet), categorize the materials each is made from, and describe how light interacts with each. To do this, the teacher will write all three types of material on the board for students. Together, the class will write a description of how light passed through each, e.g., "fabric softener sheet, translucent, allows some light to pass through", "candle holder, transparent, allows most light to shine through", and "wrapping paper, opaque, does not allow light to pass through."

IDENTIFY NEED

The teacher will tell students that many toys require some form of energy to work and light is one of the sources of that energy they use. One toy they may have seen or used that harnesses light energy is called a kaleidoscope. The teacher will challenge students to design their own kaleidoscope to learn more about how light energy, combined with the properties of translucent, opaque, and transparent materials, can be used to create different designs.

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RESEARCH THE PROBLEM

The students will learn that light passes through materials differently, not only based on the material type but also on the color of the material. This hands-on research will have students explore the difference between transparent paper, translucent paper and opaque paper.

1. Begin with cutting four square window holes in a piece of tag board (lightweight card).
2. The holes for the windows do not have to be perfect or the same size. Just bend the paper and snip with scissors. Make flaps if you want the students to be able to open and shut the windows.
3. Next have the children tape two pieces of different color transparent cellophane over 2 of the holes. Tape a piece of translucent paper (tissue paper, wax, or parchment) over another hole and a piece of opaque, light colored construction paper over the last hole.
4. Have them peek through the windows. The children can experiment with a flashlight and light from the classroom windows to see which papers the light will go through.

Differentiation:
Show students the Brain Pop, Jr. movie called, "Light." (Section on transparent, translucent, and opaque qualities of materials starts at timestamp 2:28). Link here: http://www.brainpopjr.com/science/energy/light/

Formative Assessment:
The students should share their "window" activity from above and explain it to another student from a different class, a parent, or the teacher to demonstrate their understanding. The students will use their informational display as a study guide to help them remember how light will behave as it passes through different materials and to help inform the creation of their kaleidoscope.

(**Teacher Note:** The teacher might think about making a poster similar to the example depicted below to also remind students of what they learned.)

Extension:
Read one or all of the 3 following scenarios to students. Have them turn and talk to a neighbor to discuss their choices or share them with the entire class.

Problem Scenario #1
"A neighbor was playing baseball and hit a homerun through your kitchen window. He gave you the money to buy a new window. Should your new window be opaque, transparent, or translucent? Why?" (*transparent*)

Problem Scenario #2
"Your father bought a new lamp for your bedroom, but he forgot to buy a lampshade for it. When he goes back

to buy a lampshade, should it be opaque, transparent, or translucent? Why?" (*translucent*)

Problem Scenario #3
"I want to makeover my home and use room from my bedroom to build an additional bathroom. I will need a new wall to separate the two rooms. Should the materials I use to make the wall be opaque, transparent, or translucent? Why?" (*opaque*)

DEVELOP POSSIBLE SOLUTIONS

The teacher will ask the students which types of materials allowed light to shine through the best (*the cellophane*), and then only some light through (*tissue paper*). The teacher will ask the students what effect opaque materials will have on their kaleidoscope (*dark shapes will be created from them because no light will pass through them*).

Differentiation:
Show students this interactive, online kaleidoscope maker to teach them about kaleidoscope designs. Students should talk about what shapes and colors when viewed in the circle make the "best" designs in their opinion. If used as a learning station, students can print out and save their creations as well. Link here:
http://www.permadi.com/java/spaint/spaint.html

Extension:
To gather more information for their project, the teacher will walk the students down the hallway, into the cafeteria, and outside the school building so students can look for different types of opaque, transparent, and translucent materials. Have students share as they find items and categorize them. After returning to the classroom, have students brainstorm items around the community or in their home that are transparent, translucent, and opaque.

Formative Assessment:
Make a chart on the board of the different items the students mention that are translucent, transparent, and opaque.

SELECT THE MOST PROMISING SOLUTION

The teacher and students will brainstorm a list of items they can use to make a design for their kaleidoscope containing transparent, opaque, and translucent items. The teacher will then make 2 designs as prototypes to explore (see example designs below). The teacher should let the students explore and test out the two possible kaleidoscope designs (see some easy design directions below), perhaps in a work station. Students will then make a choice about which they think is best, and why. (*The teacher should share information about the materials and process with the students if it helps them decide).*

Design #1-
The steps for this design are best viewed and followed via its website address found here:
http://thechocolatemuffintree.blogspot.com/2011/06/so-easy-kaleidoscope.html

Design #2*-
The following materials and directions can be used for the second design.

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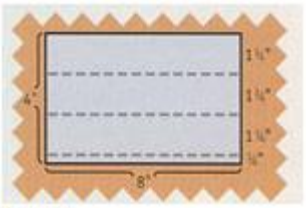
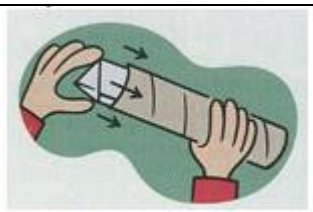
 Step 1 Draw an 8-by-4 inch rectangle on a report cover (a clear, plastic one). Cut it out. Draw three lines across the rectangle.	 Step 2 Fold the plastic along the lines to form a triangular shape. Tape the strip along the edge so it stays closed.	 Step 3 Slide the plastic triangle into the paper towel roll.	 Step 4 Turn the paper towel tube on one end. Trace a circle around it on the construction paper. Poke a hole through the circle's center and tape it over the tube.
 Step 5 Place a square of plastic wrap on the other end of the tube. Press down to create a pouch in the end of the plastic triangle. Put kaleidoscope materials in the pouch (e.g., some opaque, transparent, and translucent)	 Step 6 Place a square of waxed paper over the pouch. Stretch a rubber band over both the waxed paper and the plastic wrap. Be sure it's on tight so nothing spills out!	 Step 7 Trim the corners of the squares. Decorate the outside of the paper towel roll with stickers or wrapping paper.	 Enjoy your kaleidoscope. Hold the tube up to one eye and look through it. Turn it and watch.

*Design 2 is based on instructions found here: http://kids.nationalgeographic.com/kids/activities/funscience/be-dazzled/

Formative Assessment:
As part of a work station, students can simply choose idea "1" or "2" and show their choice by drawing a sketch of their favorite. Or, the teacher can have students answer this sentence stem orally:

"I choose _____because _____."

Differentiation:
Advanced students can write the sentence with their choice.

(**Teacher Note:** Make sure students give a rationale for their choice. Defending their decisions is a key STEM concept.) Proceed to the next step based on the class' overall choice.

CONSTRUCT A PROTOTYPE

The class will select the ONE design of the two choices for all students to now build. The teacher will have to prepare all materials needed prior to the day of construction. (**Teacher Note:** Make sure students are given items from each of the three categories (transparent, translucent, and opaque) to put into the viewing area of the kaleidoscope (sequins, see-through beads, etc.), but allow them to individually select how many and which items will go into their own kaleidoscope.

TEST AND EVALUATE PROTOTYPE

Students will draw a picture of one design they see through the eye piece of their kaleidoscope and decide if they like it or not, or how it they can improve their viewed design.

COMMUNICATE THEIR DESIGN

Students will share their kaleidoscope with a partner and explain why they decided to use the items they chose for their design.

REDESIGN

Students will discuss with the teacher how they could redesign their kaleidoscope to work if little or no sunlight was available (*e.g., artificial light from a lamp, etc.*).