It’s a Bird, It’s a Plane, It’s a WHAT?

**Curriculum/State Standards**
- Identify questions that can be answered through scientific investigations.
- Design and conduct a scientific investigation.
- Use appropriate tools and techniques to gather, analyze, and interpret data.
- Think critically and logically to make the relationship between evidence and explanations.
- Communicate scientific procedures and explanations.
- Use mathematics in all aspects of scientific inquiry.
- Understand technology used to gather data enhances accuracy and allows scientists to analyze and quantify results of investigations.

**Overview**
A four-week, hands-on interdisciplinary project unit which includes student exploration through articles and activities, which introduce vocabulary, information, and concepts about Alexander Graham Bell, his invention of the tetrahedral kite, and the role Bell and his “tetras” played in an era of aeronautical experimentation. Sixth grade science students work in pairs to construct one cell, four-cell, and 16 cell tetrahedral kites. Math, science, and social studies skills are reinforced throughout the interdisciplinary unit.

**Objectives**
The student will name the parts of a tetrahedron kite (nomenclature).
The student will identify symmetry in a kite.
The student will use problem solving skills, measuring skills, and basic geometry in the construction of the kite.

The student will define the word tetrahedron.
The student will understand how the tetrahedron grew out of Alexander Graham Bell’s search for a flying machine.
The student will understand how Bell was able to increase size without increasing weight.
The student will investigate why the tetrahedron is one of nature’s most stable structures.
The student will design and construct a 1, 4, and 16 cell tetrahedron kite.
The student will calculate the surface area of a 1, 4, and 16 cell tetrahedron and test fly for stability.

**Materials**
- 10” drinking straws
- polyester string
- tissue paper
- pipe cleaners
- scissors
- glue
- height-o-meter (altiscope)
- poster board
- markers
- colored pencils
- ruler
- protractor

**Readiness Activity**
Tetra Tops – build equilateral triangles and tetrahedrons using clay and toothpicks (building background).

**Strategies/Activities**
Research, Mathematics, Science, History concepts:
1. Define the vocabulary words, and discuss Latin roots (prefix and suffix)
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Vocabulary: gravity, lift, drag, thrust, tension, relative wind, tetrahedral, vertex, equilateral triangle.

2. Research and discuss how the tetrahedron grew out of Alexander Graham Bell’s search for a manned flying machine.
3. Discover how Bell was able to increase size without increasing weight.
4. Investigate why the tetrahedron is one of nature’s most stable structures. (Tetra Tops -Attachment)
5. Design a template for the tetrahedron sail.
6. Construct a 1 cell, 4 cell, and 16 cell tetrahedron kite using precise measurements.
7. Calculate the surface area (formula) of a tetrahedron, (1, 4, and 16 cell kites)
8. Apply scientific method to compare surface area of multi-cell tetras and conclude how the surface area relates to the stability of the tetra kite.
9. Test fly all kites and make adjustments.
10. Take notes on planning, constructing, and testing phases.
11. Written report including results of findings obtained through experience.

Building

Phase One: Making Pyramids
1. Obtain six straws, measure and cut a 72” (182.88cm) long piece of kite string. Thread 4 straws on the kite string. Hold on to the ends. Keep approximately 3” (7.62) of string towards end A. Arrange the straws onto a diamond shape and use the pipe cleaner “needle” to feed the string through the starter straw, so that it comes out between straw 1 and straw 2.
3. Add the fifth straw and place it across the center of the diamond. Feed the “needle” back through the third straw so that it comes out between straw 2 and 3.
5. Add the sixth straw. Pull up the straws so that a triangle is formed. Tie it off so that your triangles form a stable pyramid shape. Now, using steps 1-5 make 9 more pyramids.

Phase Two: Building the Kite
6. Using the template, carefully trace and cut out 20 tissue paper shapes.
7. Cover two sides of each pyramid with tissue paper. Fold the edges of the tissue paper around the straw and glue in place.
8. Assemble the kite. Begin with the bottom layer. Arrange three pyramids side by side so that they only touch by one corner and the front of each is a covered panel (all of the covered panels should lie in a plane). The other covered panel should be lying flat on the table. Knot the pyramids at the points where they meet. Arrange two pyramids behind those three so that the front covered panels of the two new pyramids faces the same direction as the front three. The back corners of the front three just meet the front corners of the two behind. Knot the two pyramids at all points that touch. Attach one more pyramid to the back corners of the row with two, again facing the covered panel forward. Be sure that all knots are secure!
9. Add the second layer of pyramids. Arrange two pyramids side by side (make sure the covered panels are on the bottom and front). Knot them to each other. Align the bottom corners of these two with the peaks of the front five pyramids on the bottom layer. Knot these two pyramids to the bottom layer. Arrange and attach a third triangle behind the two you just attached. Be sure that all knots are secure!
10. Add the third and final layer. Attach a single pyramid on top of the second level still having the covered panel facing forward. The finished kite itself looks like a giant pyramid. Be sure that all knots are secure!
11. Attach kite strings to the corners where the front panel meets the back panel. With the strings here, the panels will face downward when in flight and the triangles will look like birds in flight.
12. Add a tail to keep the kite properly oriented towards the wind.

Phase Three: Flying your Kite
13. Check the knotting. Attach flying string. Go out and fly your kite!

Culminating Activity
1. Complete Tetrahedron kite – 16 cell
2. Test flight of kites
3. Research project on Alexander Graham Bell and his tetrahedron, which also includes the procedures for finding the surface area of a tetrahedron, flight test results, a diagram and discuss why the tetrahedron is considered one of nature’s strongest figures.
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**Evaluation Method**

Rubrics:
1. Notebook grade
2. Written report on Alexander Graham Bell’s Tetra invention and results obtained from test flights, specifically, “How does surface area affect the stability in flight?”
3. Kites and the building process will be graded on following instructions, quality of construction and use of time, as well as, use of materials.