Making a pyramid….Geometry in art and architecture…
Students will use fine motor skills, spatial reasoning and problem solving to construct pyramids from drinking straws and then as a group will construct a larger pyramid from the smaller ones.

Grade Level: 4th or 5th grade

Objectives/Outcomes

- Students will know that the base of a 3 sided pyramid is a triangle.
- Students will know that a 3 sided pyramid has 4 faces.
- Students will know that a 3 sided pyramid has 6 edges.
- Students will know that the base of a 4 sided pyramid is a square.
- Students will know that a 4 sided pyramid has 5 faces.
- Students will know that a 4 sided pyramid has 8 edges.
- Students will be able to build a triangle and square based pyramid.
• Students will be able to use spatial reasoning and problem solving skills to construct a larger 3 sided pyramid using Students will deduce that Students will understand that size/scale relationships can be expressed as a fraction or ratio.
• Students will make connection between a geometric shape and a shape in art.
• Students will make a connection between the straw, a line and the edge of the pyramid forms.

Materials and Resources  
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• Solid drinking straws
  ○ (Each group will need 40 straws..6 straws for each 3 sided pyramid(4 needed), 8 straws for each 4 sided pyramid(2 needed).
• Masking tape…at least 1 to 2 rolls per group(they won’t use it all but it will be easier to share while constructing.
• Wire twisty-ties...(the kind used for trash bags or close end of veggie bags at the grocery store. You can also purchase a roll at the hardware store that is used to tie up plants and vines.)

Procedures  
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Students will apply their knowledge of geometry and solid objects to construct ‘triangular base, 3 sided’ and ‘square base, 4 sided’ pyramids. Then, in groups of 6, they will use their spatial reasoning skills and problem solving skills to construct a larger scale ‘triangular base, 3 sided’ pyramid.

1. Present the included support pictures or your assembled Powerpoint/Flipchart and talk to the class about pyramids. Establish that a triangle is a basic building block of architecture and design. It is the strongest simple geometric shape.
2. Discuss that pyramids can be made from different bases. You can use a triangle, square or any polygon. You can even use a circle. Go over the vocabulary…
3. Divide the class into groups of 6 students. If smaller groups are needed, some students will need to make multiple pyramids.
4. Within each group, they will need to make 2 square based(4 sided) pyramids and 4 triangle based(3 sided) pyramids.
5. After the group has finished making their pyramids, challenge them to figure out how to put the 6 pyramids together(like a puzzle) to make a larger triangular based(3 sided) pyramid.
6. Once they figure out the configuration, they can use the twisties to hold the smaller pyramids together and give the structure some strength and stability.

Making the triangle based(3 sided) pyramid. (6 straws needed.)

1. First, using 3 straws, use the masking tape to tape them end to end. Bend them at the joints to form an equilateral triangle. Tape off the end. This will be used as the base of the pyramid.
2. At each vertex, place a straw on top and at the edge. Use tape to attach it. Once all three are attached, pull them above and toward the center until they meet. Use tape to attach them together at the apex of the pyramid.

Making the square based (4 sided) pyramid. (8 straws needed.)

1. With 4 straws, tape them end to end together and then form a square.
2. At each vertex, place a straw on top and at the edge. Use tape to attach it. Once all four are attached, pull them above and toward the center until they meet. Use tape to attach them together at the apex of the pyramid.

Vocabulary (Return to Links)

3 sided pyramid –
A 3 sided pyramid is also called a triangular pyramid or a tetrahedron. It is a pyramid that has an equilateral triangle for a base and 3 equilateral triangles for sides. The base and sides are called the faces of the pyramid. There are 4 total.

4 sided pyramid -
A 4 sided pyramid is also called a square pyramid. It is a pyramid that has a square base and 4 equilateral triangles for sides. The base and sides are called the faces of the pyramid. There are 5 total.

Face - Any flat side of a solid geometric shape.

Edge – The line segment where 2 faces of a shape meet.

Vertex – the corners or points at which the sides of a triangle meet.

Apex – The vertex that forms the highest point of a triangle or pyramid.

Equilateral triangle – A triangle with equal sides and angles

Line – The real or implied path made by a moving point.

Shape - A two dimensional/flat space bordered by a real or implied line with a regular or irregular geometric shape.

Form – A three dimensional form bordered by real lines or edges that encloses volume.
Criteria for Assessing Student Learning

“The formal definition of intelligence is "the capacity to acquire and apply knowledge." One aspect or kind of intelligence, according Dr. Howard Gardner, founder of the multiple intelligence theory, is spatial intelligence. Spatial intelligence is one amongst eight kinds of intelligence. The most common description of spatial intelligence is the ability to be able to recreate one's visual experience and reasoning about shape, measurement, depiction and navigation.”


General statement: Using the constructed shapes, students are able to use them to construct the same shape on a larger scale.

Target Learning: Construct triangular and square based pyramids
Assessment Criteria: Students use fine motor skills to assemble small scale pyramids using drinking straws and masking tape.

Target Learning: Change scale in a work of art
Assessment Criteria: Enlarges the size of an object or shape from a work of art.

Target Learning: Collaborates with classmates
Assessment Criteria: Works collaboratively with group to ensure that all smaller shapes fit together to form a larger scale shape of the original objects.

Lesson Content Standards

California Content Standards in Visual & Performing Arts
(There are art sub-standards by grade level. These are the high level standards that guide instruction at all grade levels.)

1.0 ARTISTIC PERCEPTION (Learn & Talk)
Processing, Analyzing, and Responding to Sensory Information through the Language and Skills Unique to the Visual Arts.
Students perceive and respond to works of art, objects in nature, events, and the environment. They also use the vocabulary of the visual arts to express their observations.

2.0 CREATIVE EXPRESSION (Make)
Creating, Performing, and Participating in the Visual Arts.
Students apply artistic processes and skills, using a variety of media to communicate meaning and intent in original works of art.

3.0 HISTORICAL AND CULTURAL CONTEXT (Learn, Look & Talk)
Understanding the Historical Contributions and Cultural Dimensions of the Visual Arts.
Students analyze the role and development of the visual arts in past and present cultures throughout the world, noting human diversity as it relates to the visual arts and artists.

4.0 AESTHETIC VALUING (Talk)
Students analyze, assess, and derive meaning from works of art, including their own, according to the elements of art, the principles of design, and aesthetic qualities.

5.0 CONNECTIONS, RELATIONSHIPS, APPLICATIONS (Connect)
Connecting and Applying What Is Learned in the Visual Arts to Other Art Forms and Subject Areas and to Careers.
Students apply what they learn in the visual arts across subject areas. They develop competencies and creative skills in problem solving, communication, and management of time and resources that contribute to lifelong learning and career skills. They also learn about careers in and related to the visual arts.

California Content Standards in Math (Return to Links)

4th Grade Standards

3.0 Students demonstrate an understanding of plane and solid geometric objects and use this knowledge to show relationships and solve problems:

3.6 Visualize, describe, and make models of geometric solids (e.g., prisms, pyramids) in terms of the number and shape of faces, edges, and vertices; interpret two-dimensional representations of three-dimensional objects; and draw patterns (of faces) for a solid that, when cut and folded, will make a model of the solid.

3.7 Know the definitions of different triangles (e.g., equilateral, isosceles, scalene) and identify their attributes.

3.8 Know the definition of different quadrilaterals (e.g., rhombus, square, rectangle, parallelogram, trapezoid).

Mathematical Reasoning

1.0 Students make decisions about how to approach problems:
1.1 Analyze problems by identifying relationships, distinguishing relevant from irrelevant information, sequencing and prioritizing information, and observing patterns.

2.0 Students use strategies, skills, and concepts in finding solutions:
2.2 Apply strategies and results from simpler problems to more complex problems.

5th Grade Standards

Measurement and Geometry
2.0 Students identify, describe, and classify the properties of, and the relationships between, plane and solid geometric figures:

Mathematical Reasoning
1.0 Students make decisions about how to approach problems:
   1.1 Analyze problems by identifying relationships, distinguishing relevant from irrelevant information, sequencing and prioritizing information, and observing patterns.

3.0 Students move beyond a particular problem by generalizing to other situations:
   3.1 Evaluate the reasonableness of the solution in the context of the original situation.
   3.2 Note the method of deriving the solution and demonstrate a conceptual understanding of the derivation by solving similar problems.
   3.3 Develop generalizations of the results obtained and apply them in other circumstances.

**Other Resources**  
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(The information below can be used as is or as resource materials to put together your own PowerPoint or Flipchart presentation.)

**Images of pyramids in art and architecture….

Great Pyramids in Giza, Egypt**
Pyramid at the Louvre Museum in Paris, France

Luxor Hotel and Casino in Las Vegas, Nevada
Transamerica building in San Francisco, California

Optical illusion with triangles.

Triangles in the rafter construction for house roofs
Triangle in shape of roofs

A Frame House
Swing sets...

Bicycle frames..
**Beyond the basics…**

1. The basic lesson had the students using 2 square based pyramids and 4 triangle based pyramids to construct a larger 2 tiered triangular based pyramid. Challenge your students to do the following….

   - Combine 3 of your groups and see if they can figure out how to make a 3 tiered pyramid. They will need approximately 6 square based pyramids and 12 triangle based pyramids.
   
   - Using only ‘square based pyramids’, can you make a 2 tiered square pyramid using 6 of the smaller pyramids? How about using only 5?

2. Included below are instructions for cutting out both a triangle(3 sided) pyramid and a square(4 sided) pyramid.
Geometric Forms: Three-sided Pyramid

1. Cut out a square
2. Fold diagonally.
3. Unfold and fold diagonally the other way.
4. Cut from one corner to center.
5. Pull the two sides together so they overlap.
6. Glue between overlapping sides.
7. For a bottom, trace the base on paper. Add tabs.
8. Cut out your shape.
9. Bend in tabs and insert inside pyramid. Tape or glue shut.
Geometric Forms

Four-sided Pyramid

1. Cut out figure along solid lines.
2. Fold along all dotted lines.
3. Bring the pyramid together
4. Glue or tape the tabs to the pyramid.