Tri Tri Again Assessment

Have you ever wondered how bridges stand up? How do such frail-looking frameworks stretch through the air without falling? How can they withstand the twisting forces of hurricane winds and the rumbling weight of trucks and trains? Part of the answer lies in the natural strength of triangles.

In your assessment for this unit, you will explore how engineers use triangles to construct safe, strong, stable structures. You then will have a chance to apply these ideas as you design and build your own bridge with toothpicks or craft sticks. You will see how a simple shape often can be the strongest one.

This will be accomplished by working in a small group. The assessment is due Wednesday June 5. Any late assessments will be given at most a grade of 50%. Points will be deducted for projects that are not neat, legible, and/or grammatically correct, well-written (spelling and mechanics). Throughout all the activities, each group should keep a journal that includes the answers to all of the questions (with explanations) along with records of what you have done, experiments you have done, etc…

List of Materials

- Sheet of cardboard
- Stapler
- Toothpicks or craft sticks
- Glue

Activity 1: Modeling

Many structures have straight beams that meet at joints. You can use models to explore ways to strengthen joints.

- Cut seven cardboard strips approximately 6 in. by $\frac{1}{2}$ in. Make a square frame (I below) and a triangular frame (II below). Staple across the joints as shown.

I. II. III.

- With your fingertips, hold each model flat on a desk or table, and try to change its shape. Which shape is more stable?
- Cut another cardboard strip, and use it to form a brace (III above) for the square frame. Is it more rigid? Why does the brace work?

Activity 2: Observing

Visit local bridges, towers, or other structures that have exposed frameworks, or find LOCAL examples on the internet (be sure to cite where you got them). You should include a list of what you have found in your journal. Examine these structures for ideas you can use when you design and build a bridge later in this assessment. Record your ideas. Sketch, take or download pictures of the structures. On the sketches or photos (either electronically or on a hard copy),, show where triangles are used for stability. You must have a minimum of 3 structures, and all must be located within 50 miles of Richmond, Virginia.

Activity 3: Investigating

CUBE TRIANGULAR PYRAMID

In the first activity, you tested the strength of two-dimensional models. Now investigate the strength of three-dimensional models.

Use toothpicks or craft sticks and glue to construct a cube and a tetrahedron (a triangular pyramid).

- Which model is stronger?
- Describe how you could strengthen the weaker model.

Use toothpicks or craft sticks and glue to construct a structure that can support the weight of your geometry book. Describe and sketch what you have made in your journal.

Finishing the Unit Assessment

Design and construct a bridge made entirely of glue and toothpicks or craft sticks. Your bridge must be at least 8 inches long and contain no more than 100 toothpicks or no more than 30 craft sticks. With your group, decide how to test the strength of the bridge, and record not only the method(s) but why you think it would work. Record the dimensions of your bridge, the number of toothpicks or craft sticks used, and the weight the bridge could support. Experiment with as many designs and models as you like-the more the better. Include a detailed summary of your experiments with notes about how each one helped you improve your design.

Reflect and Revise

As a group to review your project. Together, check to be sure that your bridge meets all the requirements and that your diagrams and explanations are clear. Have you tried several designs and kept a record of what you learned from each? Can your bridge be stronger or more pleasing to the eye? Can it be built using a more efficient design? Revise your work as needed. Explain everything and use complete sentences, good grammar, spelling, and mechanics.

Assessment Checklist

Have you done all of the following, and explained them in your journal?

- Pushed or pulled the models only along the plane of the frame.
- Looked for small design features that are used repeatedly in real structures.
- Determine the strength of three-dimensional models.
- Tested small parts of the bridge before building the entire structure. Planned the order in which you assemble and glue the different sections.

Scoring Guide

You will be assessed using Criterion B and D. The rubrics are below. Be sure to read over this before you begin and refer to it often. Also, when you are done with your assessment, use the rubric to score it to be sure you have met the highest band possible!

Criterion B: investigating patterns

Maximum 8

Students are expected to investigate a problem by applying mathematical problem-solving techniques, to find patterns, and to describe these mathematically as relationships or general rules and justify or prove them.

This criterion examines to what extent the student is able to:

- select and apply appropriate inquiry and mathematical problem-solving techniques
- recognize patterns
- describe patterns as relationships or general rules
- draw conclusions consistent with findings
- justify or prove mathematical relationships and general rules.

Assessment tasks for this criterion should be mathematical investigations of some complexity, as appropriate to the level of MYP mathematics. Tasks should allow students to choose their own mathematical techniques to investigate problems, and to reason from the specific to the general. Assessment tasks could have a variety of solutions and may be set in real-life contexts. Teachers should clearly state whether the student has to provide a justification or proof.

Teachers should include a good balance between tasks done under test conditions and tasks done at home in order to ensure the development of independent mathematical thinking.

Achievement level	Descriptor
0	The student does not reach a standard described by any of the descriptors given below.
1 – 2	The student **applies, with some guidance**, mathematical problem-solving techniques to recognize **simple** patterns. Indicators: 1. Diagrams and explanations are included. 2. Questions are answered with some explanation.
3 – 4	The student **selects and applies** mathematical problem-solving techniques to recognize patterns, and **suggests** relationships or general rules. Indicators: 1. Diagrams and explanations are included. 2. Questions are answered clearly, with some accuracy and some explanation.
5 – 6	The student **selects and applies** mathematical problem-solving techniques to recognize patterns, **describes** them as relationships or general rules, and **draws conclusions** consistent with findings. Indicators: 1. All diagrams and explanations are clear. 2. Questions are answered clearly, accurately, and thoroughly. 3. Determines the most efficient design.
7 – 8	The student **selects and applies** mathematical problem-solving techniques to recognize patterns, **describes** them as relationships or general rules, **draws conclusions** consistent with findings, and **provides justifications or proofs.** Indicators: 1. All diagrams and explanations are clear. 2. Questions are answered clearly, accurately, and thoroughly. 3. Determines the most efficient design with a detailed justification.

Notes

1. Pattern: the underlining order, regularity or predictability between the elements of a mathematical system. To identify pattern is to begin to understand how mathematics applies to the world in which we live. The repetitive features of patterns can be identified and described as relationships or generalized rules.
2. Justification: a clear and logical mathematical explanation of **why** the rule works.
3. Proof: a mathematical demonstration of the truth of a given proposition.

Criterion D: reflection in mathematics

Maximum 6

Reflection allows students to reflect upon their methods and findings.

This criterion examines to what extent the student is able to:

• explain whether his or her results make sense in the context of the problem
• explain the importance of his or her findings in connection to real life
• suggest improvements to the method when necessary.

Assessment tasks are most likely to be investigations and real-life problems. Generally these types of tasks will provide students with opportunities to use mathematical concepts and skills to solve problems in real life contexts.

Achievement level	Descriptor
0	The student does not reach a standard described by any of the descriptors given below
1 – 2	The student **attempts** to explain whether his or her results make sense in the context of the problem. The student **attempts to describe** the importance of his or her findings in connection to real life. Indicators: 1. An account of the experiments is given, including how they led to improved designs. 2. An explanation of how this connects to real-life is included.
3 – 4	The student **correctly but briefly explains** whether his or her results make sense in the context of the problem and **describes** the importance of his or her findings in connection to real life. The student **attempts** to justify the degree of accuracy of his or her results where appropriate. Indicators: 1. An account of the experiments is given, including how they led to improved designs. 2. An accurate explanation of how this connects to real-life is included.
5 – 6	The student **critically explains** whether his or her results make sense in the context of the problem and provides a **detailed explanation** of the importance of his or her findings in connection to real life. The student **justifies** the degree of accuracy of his or her results where appropriate. The student **suggests improvements** to the method when necessary. Indicators: 1. A complete account of the experiments is given, including how they led to improved designs. 2. A detailed and accurate explanation of how this connects to real-life is included. 3. Method improvements are suggested, or a justification of why no improvements are necessary.

Notes

1. Describe: present an account without providing reasons or explanations.
2. Explain: give a detailed account including reasons, causes or justifications. Explanations should answer the questions "why" and "how".