MODIFIED UBD LESSON PLAN

COURSE: Investigating STEM Skills		
UNIT: Problem Solving	**EXERCISE:** Exploring Tension and Compression	**TIME FRAME:** 1 Hour

PREPARATION: *Summary of "to do's" that the teacher should understand and prepare before bringing this lesson to the classroom.*

Teachers will need to ensure that the proper supplies are available for students to build their solutions.

The Start-up kits and consumable kits are available from NASCO here:

https://www.enasco.com/page/Science/STEM-Academy_Curriculum-Kits

Select your options:

- Start-up kit (24 Students)
- Start-up add on kit (4 Students)
- Consumable kit (24 Students)

From the kit you will need these items:

Materials:

- Regular boards
- Long boards
- Bolts
- Cables
- Wing nuts or hex nuts

SAFETY: *Summary of safety strategies in the lesson.*

Please use this space to describe safety procedures or highlights for this lesson.

S1 DESIRED RESULTS:

ESTABLISHED GOALS:

Problem Solving Techniques and Applications Standards:

Teachers should use the STEM Academy Standards Correlation System available in the STEM Connections area of a unit to extract specific standards and insert these standards here.

TRANSFER:

Students will be able to independently use their learning to…

- Be able to creatively problem solve

MEANING:

UNDERSTANDINGS

Students will understand that...

- Proper analysis in engineering and the design process are essential for engineers
- Estimation provides quick answers or problems and verifies complicated analyses
- Engineers need to be good at solving problems and making things
- Many engineering problems are open-ended and complex

ESSENTIAL QUESTIONS

Students will keep considering...

- What are critical components to becoming a successful engineer or problem solver?
- How is estimation a useful tool?
- How does dividing the creative problem solving process into steps help you follow a more complete and careful problem-solving procedure?

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ACQUISITION OF KNOWLEDGE AND SKILL:	
Students will know...	*Students will be skilled at...*
• Engineering design • Problem solving • Analytic and creative aspects • Estimation • Problem statements • Creative problem solving • Five-question method	• Communicating the engineering design process • Performing the 10-step design process • Developing a solution using the engineering design process • Making a problem statement • Simplifying the assumptions • Solving the necessary problems • Verifying accuracy to required level

S2 EVIDENCE:

EVALUATIVE CRITERIA:	ASSESSMENT EVIDENCE:
• Graded rubric	*Performance Task(s):* Exploring Tension and Compression Lab
• Thoughtful, clear, thorough • Graded on accuracy, multiple-choice questions • Completed on time	*Other Evidence:* • Online end-of-unit test

S3 LEARNING PLAN: *Summary of Key Learning Events and Instruction*

Pre-Assessment:

Problem Solving Pre-Test

Lab 1 Exploring Tension and Compression Directions:

1. Lay out four boards in the shape of a square.
2. Align the predrilled holes and put one 2" bolt through each hole.
3. Thread one wing nut on each bolt.
4. See photo for what your square should look like.
5. Pick up the square with one hand gripping in the middle of one board. Hold the board in a vertical position.
6. Describe what happens to the square's shape when you pick it up. Why does this happen?
7. Remove two bolts in opposite corners and Then add the wood crosspiece to your square. Tighten the nuts. You should now have a square that is divided into two triangle shapes.
8. Set the square on the floor in front of you and gently push down on the top of the square and rock it from side to side.
9. Describe what happens to the square's shape when you rock it from side to side.

10. Circle one. When you push the top of the square from side to side the wood cross brace keeps the square from collapsing. Why is this?
    - The wood cross brace can only resist the force of compression.
    - The wood cross brace can only resist the force of tension.
    - The wood cross brace resists the forces of tension and compression.
    - The wood cross brace can only resist the force of gravity.
11. Remove the wood cross brace and add one cable brace in its place
12. Try this. Pick up the square with one hand gripping in the middle of one board. Hold the board in a vertical position. Now hold the square up by each side. Watch your fingers if one side collapses.
13. In the diagrams below, circle the structures that will hold their shape, and put an X on the structures that will collapse. The cross brace is a cable.
14. Try this. Set the square on the floor in front of you and gently push down on the top of the square and rock it from side to side.
15. Now do this. Draw how the squares will look in the diagram.
16. Circle one. When you push the top of the square from side to side the cable cross brace keeps the square from collapsing. Why is this?
    - The cable cross brace can only resist the force of compression.
    - The cable cross brace can only resist the force of tension.
    - The cable cross brace resists the forces of tension and compression.
17. Explain why the frame in the picture is not a square. Why has the single cable brace not kept the square from collapsing? Use the terms tension and compression.
18. Add a second cable brace to make an X in the box.
19. Pick up the square with one hand gripping in the middle of one board. Hold the board in a vertical position and carefully shake it around.
20. Set the square on the floor in front of you and gently push down on the top of the square and rock it from side to side.
21. Circle one. When you push the top of the square from side to side the two cable cross braces keep the square from collapsing. Why is this?
    - The cable cross braces can only resist the force of compression.
    - The cable cross braces can only resist the force of tension.
    - The cable cross braces resists the forces of tension and compression.
    - The cable cross braces can only resist the force of gravity.
22. The right side of this gate drags in the dirt when it is opened. How can this gate be repaired if you only have cable or wire to do the job? Draw the repaired gate to the right. Use the least amount of material to do the job?

Progress Monitoring:
Teacher observes students and provides on-going feedback during the activity. While introducing the unit, the teacher will pause and ask for questions to make sure everyone understands.

Students will complete self-assessment and brainstorm how they could improve their skills in the future. At the end of the unit, there will be a quiz to measure their overall understanding.

DIFFERENTIATION: *Summary of Key Differentiation Techniques*

Please use this space to insert your differentiation techniques. Depending on the needs of students, various techniques might be needed in a classroom, therefore use the information below and experts in the area needed to design your plan for differentiation.

The ASCD Study Guide for Integrating Differentiated Instruction and Understating by Design: Connecting Content and Kids.
by Carol Ann Tomlinson, Jay McTighe

Integrating Differentiated Instruction and Understating by Design: Connecting Content and Kids.
by Carol Ann Tomlinson, Jay McTighe
ISBN-13: 978-1416602842
ISBN-10: 1416602844

Differentiating Reading Instruction
by Laura Robb.
ISBN13: 9780545022989

A Teacher's Guide to Differentiating Instruction
The Center for Comprehensive School Reform and Improvement

CAREER CONNECTIONS: *Summary of Career Opportunities Associated with this Lesson*

Please use this space to insert careers that might be connected to this lesson. This section will need continuous updating as new careers and emerging technologies change the opportunities available in the workforce.

Good sources for career connections:

Occupational Outlook Handbook
http://www.bls.gov/ooh

The National Career Clusters® Framework
http://www.careertech.org/career-clusters

KEYWORDS: *Please Insert Keywords from this Lesson with their Definitions*

Please use this space to insert keywords and their definitions
Use resources like dictionary.com to find definitions to your keywords