| SeaGlide_TEAM | Plan | Lesson #5 (60 minutes) |
|---|---|---|

**Description:**

Students will implement the steps within the *Plan* portion of the engineering design process which is broken down into three major categorizes: developmental work, refinement and improvement, and risk reduction. They will continue their roles as Civil Engineers as well as continue to work on their Bridge Design projects. This is the fourth lesson of the six lesson unit project. Students will implement what they have researched, brainstormed, and learned in previous lessons to create a detailed technical drawing of their bridge design. Students will include geometric details, dimensions (scaling), forces, and tolerances. After completion and grading, their drawings will be added to their engineering design binders to be accessible for reference.

**Students will be able to:**

- Describe and apply the steps of the technical drawing method
- Use analytical evidence to make predictions about their bridge structures
- Use evidence to support decisions
- Use geometrical skills to calculate dimensions and scaling

**Students will understand:**

The *Plan* portion of the engineering design process involves the developmental work and risk reduction. This part of the engineering design process is important because it allows for the generating of a refined construction plan which includes as many details as possible. Students will implement the technical drawing method to create a detailed scaled down blueprint of their bridge design. Students will then analyze the effects of Earthquakes on bridge structure and make risk reduction applications on their bridge designs.

**Key Definitions & Concepts: [1]**

- **Computer Aided Design (CAD)**: computer technology software that create precise two-dimensional or three-dimensional technical illustrations to design a product and documents the design process [2].
- **Dimension**: size of the object measured in one direction.
- **Geometry**: shape of the object.
- **Material**: represents what the item is related to, derived from, or consisting of matter.
- **Richter scale**: an open-ended logarithmic scale for expressing the magnitude of a seismic disturbance in terms of energy.
- **Scaling**: the pattern, make, regulate, set or estimate according to some rate or standard.
- **Technical Drawing**: a precise and detailed drawing of an object, as employed in architecture or engineering.

**Standards: [Copied from: 3]**
HS-ETS1-2. Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.

RST.11-12.7. Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem.

## Background Information

**Prior Knowledge:**

- Logical Thinking
- Measuring and scaling techniques
- The Engineering Design Process
- Forces and tolerances

| Science Practices: [Copied from: 4] | Core Ideas: [Copied from: 5] | Cross Cutting Concepts: [Copied from: 6] |
|---|---|---|
| • Developing and Using Models<br>• Using Mathematics and Computational Thinking<br>• Constructing Explanations and Designing Solutions | • Defining and Delimiting Engineering Problems<br>• Optimizing the Design Solution | • Patterns<br>• Cause and Effect<br>• Scale, Proportion, and Quantity<br>• Structure and Function<br>• Stability and Change<br>• Influence of Science, Engineering, and Technology on Society and the Natural World |

**Possible Preconceptions/Misconceptions:**
Since this lesson is an extension of the engineering design process, students should be able to complete this lesson successfully. This lesson is designed in a way to help students thoroughly understand any associated concepts through discussion. Misconceptions might arise after watching the video during the introduction to the exploration of this lesson. The video discusses topics, such as the use of different viewing directions within the geometry of an object, adhering to a strict set of rules and measurement standards, special symbols, and the title block, that the students will not be covering in their blueprints. This may lead to confusion, but the instructor should be responsible for making the learning goal explicitly clear. By working through the half sheet that is associated with the technical drawing videos, students should have a clear idea about which topics are most relevant to what they will be doing for their blueprints.

| | Lesson Plan - 5E(+) Model | |
|---|---|---|

**Engage:**
The instructor will hand out the *Engineering Design Process: Imagine Review* pre-quiz for students to complete individually and turn in for grading. The pre-quiz will have students read through a scenario and prompt them to identify the different steps within the *Imagine* potion of the engineering design process. Students should create a problem statement in the correct format, brainstorm alternate solutions, choose the best solution that fits all the requirements and explain why they chose that solution. The purpose of this pre-quiz is to have students review and recall the material covered in the previous lesson. The goal is to have students use problem based learning to show that they have full understanding of this portion of the engineering process. This section should take 5 minutes to complete.

**Explore:**
Part I: Introduction: [7]
The instructor will hand out the *Introduction to Technical Drawing* half sheet for students to complete individually while watching the video and turn in for grading. Students will watch a short video (Video Link) that is an introduction to technical drawing in engineering and helps beginners understand the basics of the various elements that make up technical drawing. The purpose of the half sheet is to have students understand the importance of technical drawings and show that they understand the basics presented in the video. The goal is to have students explain the elements in an manner that is easier for them to understand so that they will be able to implement those elements in their own technical drawings. This section should take about 5 minutes to complete.

Part II: *Benchmark Lesson*: Bridge Design Blueprint [8-10] (images)
Students will get into their Bridge Design project groups, and the instructor will distribute the *Bridge Design Project: Developmental Work* activity worksheet as well as their engineering design binder. Using what they have researched, brainstormed, and learned from previous lessons, students will create a detailed technical drawing (blueprint) of their bridge design based on the solution they decided to pursue. Students will focus on the geometry, dimensions, forces, and tolerances. Students should be as detailed as possible so that their building process will run smoothly. In the section dealing with forces and tension, students should not draw their entire bridge in full detail a second time. Instead, students should explain the way force is distributed by using visual explanations such as a diagram. Encourage students to distribute the workload between the members of their groups and hold discussions within their group to help each other understand the details of their drawings. The purpose of this activity is to have students implement their research and brainstormed ideas to create a concrete plan that will be used in the construction of their bridges. Students will also learn about scaling, dimensions, and force distribution and how those properties are displayed on their bridges. The goals and expectations of this project can be found on the attached rubric titled, *Bridge Design Project Rubric*. This section should take about 30 minutes to complete.

Part III: *Investigation Lesson*: Seismic Resilience in Bridge Structures [11], [12], [13], [14], [15], [16]
Once each group has completed their technical bridge drawings, students will remain in their groups and complete an activity analyzing seismic resilience in bridge structures in Portland, Oregon. Students will read through three short descriptions on the design details of major bridges in Portland.

The descriptions will include predictions on whether that bridge will withstand an earthquake or collapse. Students will then rank the bridges based on their likelihood of collapsing in the event of an earthquake. Students will also make predictions about their bridge designs based on comparing their designs to those located in Portland. Students will be required to provide evidence to explain the reasoning behind their responses. The purpose of this section is to have students conduct risk assessment on their bridge design and make plausible predictions of what would occur in the event of a natural disaster. This section should take about 15 minutes to complete.

**Explain:**

Throughout the exploration, students will engage in discussions that inquire their understanding and knowledge of the information at-hand. Instructors will be informally asking students to explain their solutions and thought processes throughout the entirety of the lesson. The worksheets in the engage and explore portion of the lesson will ask questions that will require students to engage in higher level thinking, allowing them to verbalize and self-assess their understanding of the material.

**Elaborate:**

The elaboration of this lesson is the investigation section of the lesson. Civil Engineering is a career path that involves a wide range of skill sets and works within the environment, construction, transportation, and several other areas that impact everyday life. The engineering design process lays the foundation for all engineering based projects and designs. Creating a detailed technical drawing is an essential part of that process. The student-led exploration activity allows the students to gain the mindset of an engineer by dissecting a real-world scenario.

**Evaluate:**

This lesson is designed to have both informal and formal evaluations throughout its entirety. The informal evaluations occur throughout the exploration because of the leading open-ended questions. This allows the instructor to gauge surface-level student understanding. This is done through listening to student conversations and observing how students work through the activity worksheets. During this time, the instructor has the ability to hear and address any misconceptions or misunderstandings as necessary. The formal evaluation of this lesson is the engage pre-quiz, the investigation activity worksheet, and the exit ticket. The exit ticket is a 5 minute, individual activity which has the students use what they have learned throughout the entirety of the lesson by comparing differences in bridge material and structures and how that affects the resilience to extreme weather. The purpose of the exit ticket is to have students show they have full understanding of those topics.

**Enrich:**

The lesson could be differentiated by having students perform risk assessment calculations based on the likelihood of the consequences faced in several different disruption scenarios. A few examples of these scenarios include: high winds, earthquakes, floods, and collisions. For example, students could create a mathematical model that analyzes the vibrations a bridge experiences during an Earthquake with a magnitude of 9.0 on the Richter scale. Performing risk assessment calculations allow students to perform thorough developmental work and optimize risk reduction in their engineering designs.

These types of assessments are commonly seen in college-level engineering courses and can be carried into real-world careers that work in preventative risk assessment to create safer structures. Hence, this lesson can be differentiated into a college-level engineering course as a beginning-term freshman project.

**All associated documents are attached below**

**Reference *Annotated Bibliography* on the very last page of this packet**

Name: ______________________________________________ Date: ______________

# Engineering Design Process: *Imagine* Review

**Scenario**: Your friend, Duke, has a hard time getting to school on time. He feels that missing the first 30 minutes of class is putting him behind and causing him to perform poorly on his assignments. He comes to you for advice. His morning routine includes waking up 45 minutes before he has to leave for school. He has to make sure he walks the family dog each morning before he leaves. Since he lives 1.2 miles away from school, he allots 15 minutes to walk to school and stops by the local coffee shop to grab a coffee every morning.

**Directions**: Using the scenario above, help Duke find a solution to ensures he makes it to school on time each morning.

1. Identify the problem and generate a problem statement using the correct format.

2. Generate several alternate solutions for Duke.

3. Choose the best solution that fulfills all of the requirements. Explain why you choose your solution.

Name: ______________________________________________ Date: ______________

## Introduction to Technical Drawing Worksheet [7]

1. Identify the four major aspects you would find in a technical drawing.

2. What is the title block? Why is it important?

3. Why is the manufacturing detail the most important aspect when communicating a design to a manufacturer?

4. What are the two methods for producing a technical drawing

Name: ______________________________________________ Date: ______________

## Introduction to Technical Drawing Worksheet [7]

1. Identify the four major aspects you would find in a technical drawing.

2. What is the title block? Why is it important?

3. Why is the manufacturing detail the most important aspect when communicating a design to a manufacturer?

4. What are the two methods for producing a technical drawing?

Name: ______________________________________________________ Date: ________________
Engineering Partner Name: ____________________________________________________________

# Bridge Design Project: Developmental Work [8-10]

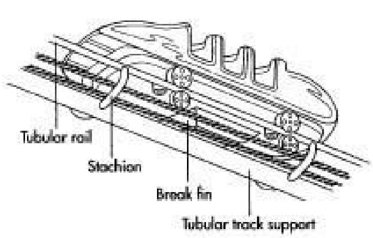
**Introduction:** Creating a blueprint drawing of a project design is an important method Engineering. Engineers use technical drawings to effectively communicate and to allow for their design to be presented in a standardized manner that can be understood by all levels within engineering. Technical drawings capture all of the geometric details of a product. This method allows engineers to communicate the precise intent of the drawing as well as allow manufacturers know how to create the parts without the need for additional explanation.

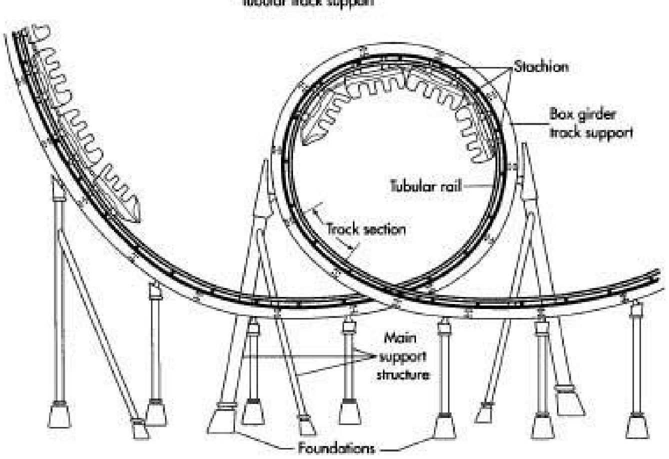
**Engineering Design Process:**

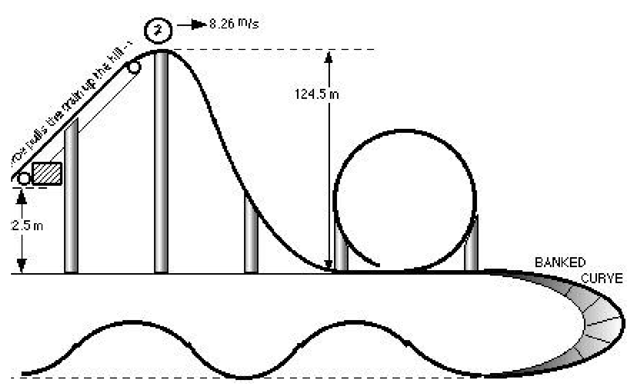
Ask
Imagine
**Plan** → Developmental Work / Refinement and Improvement / Risk Reduction
Create
Test

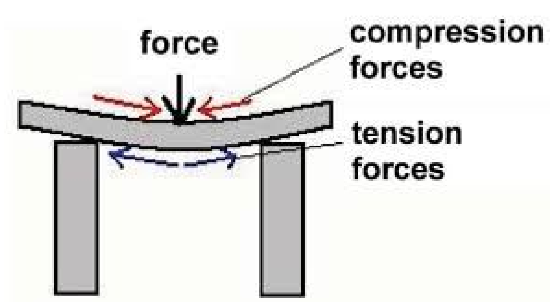
**Directions:** Today, you will focus on the *Plan* portion of the engineering design process. During the *Imagine* portion of the engineering design process, your team generated alternate solutions and chose the solution that you felt best met all of the requirements. You will use the technical drawing method to create a **detailed** scaled-down blueprint of your bridge design. Your blueprint must include the geometry, dimensions, tolerances, and the way forces act upon your bridge. Use your research notes to help with the specifications of your bridge. Make sure your sketch is as detailed as possible so that you will be prepared when it comes to building your bridge prototype. Below are some examples of technical drawings:

**Technical Drawing Examples:**



**Directions**: include an overall technical drawing of your bridge showing the geometry and dimensions.

**Directions**: draw how forces act upon your bridge and the tolerances.

# [1]Seismic Resilience in Portland, Oregon Bridges [11-15]

**Morrison Bridge**

A "Chicago-type double-leaf" bascule bridge that spans about 3700 ft and is 90 ft wide. The Morrison Bridge is an important link to the inner city network of highways and bridges within Portland. The bridge consists of two steel deck truss side spans and a bascule draw span. The bridge contains counterweights located inside each pier weighing 950 tons which are used to raise the lift span leafs. The east approach contains structures reinforced with concrete deck and steel girder. The west approach contains concrete decks with steel girders supported by reinforced concrete columns and caps. In the event of an earthquake with a magnitude of 8.0-9.0 on the Richter scale, the bridge could experience column failure. In addition, the approaches of the bridge are at risk as well.

**Interstate 5 Bridge**

A pair of twin truss bridges that span over 3500 ft over the Columbia River between Portland, Oregon and Vancouver, Washington. The bridge contains a twin lifts which rely on concrete counterweights that hang on cables running over pulleys at the top of the north and south ends of the spans. Two concrete blocks are located at the top of the counterweights which allows for maintaining the lift span's weight balances. In the event of an earthquake with a magnitude of 8.0-9.0 on the Richter scale, the bridge would collapse. The drawbridge towers holding the counterweights would buckle causing the counterweight concrete blocks to fall. In addition, the middle spans of the bridge would collapse and break into pieces. The supports of the approaches on either side of the bridge would liquify due to the saturated, sandy material.

**Sellwood Bridge**

A deck arch bridge that spans over 1900 ft crossing the Willamette River. The bridge contains a total of three arches and two piers which are filled with steel. The foundation of the bridge reaches the bedrock underneath for reinforced support. The bridge replaced an older version of the Sellwood bridge due to deterioration of the support and approaches in the bridge. The approaches contained cracks in the concrete which have been building up since the 1960s. In the event of an earthquake with a magnitude of 8.0-9.0 on the Richter scale, the bridge would survive with minor damages. This is due to the fact that the bridge was constructed to high stands for seismic resilience in addition to reinforcement of the approached to prevent a landslide. The steel in the piers allow for flexibility, bending, and energy absorption without collapsing.

[1] Sources: Morrison Bridge Link | Portland Bridges Article | Portland Bridges Explained | Interstate 5 Bridge | Sellwood Bridge

Name: ______________________________________________________ Date: ________________
Engineering Partner Name: ___________________________________________________________

# Portland, Oregon Bridges Analysis

**Directions:** Read the descriptions of three bridges located in Portland, Oregon. The descriptions contain the necessary information that will lead you to understanding what materials, build structure, and other qualifications that affect the lifespan of a bridge against a strong earthquake. Using the information given in each bridge description, answer the following questions:

1. Rank the bridges in increasing likelihood of collapsing due to an earthquake. Provide supporting evidence about the structures and materials that would degrade from or provide support against an earthquake with a magnitude of 8.0 - 9.0 on the Richter scale.

   Least Likely to collapse: _________________________
   Why?

   Middle-grade likelihood to collapse: _________________________
   Why?

   Most Likely to collapse: _________________________
   Why?

2. Which bridge provided is most similar to your design? Provide detailed evidence.

3. If your bridge were to experience an earthquake with a magnitude of 8.0 - 9.0 on the Richter scale, what it your expected outcome? Why? (Be sure to explain the connections of both the structure and the materials of your bridge to withstanding or collapsing from an earthquake).

Name: ______________________________________________ Date: ______________

# Exit Ticket: Comparing Bridges [15], [16]

**Directions**: Utilize the Venn Diagram and the prompt to answer the concluding challenge question.

| [2]**Interstate 5 Bridge** | **Similarities** | [3]**Akashi Kaikyo Bridge** |
|---|---|---|
| • **Location:** Portland, OR - Vancouver, WA<br>• **Type:** Truss Bridge with a vertical-lift draw<br>• **Span:** 3538 ft.<br>• **Height:** 230 ft.<br>• **Materials:** Concrete and Steel<br>• **Features:**<br>○ Implements a vertical lift that utilizes concrete counterweights (to maintain the lift-span's weight balances). | • Used as roadways to allow for ships to pass below<br>• Implement a truss design<br>• Use steel as the main material for the bridge structure<br>• Implement a special feature to maintain the balance of the bridge | • **Location:** Kobe, Japan - Awaji-Shima, Japan<br>• **Type:** Suspension bridge with truss support<br>• **Span:** 12,828 ft.<br>• **Height:** 928 ft.<br>• **Materials:** Steel<br>• **Features:**<br>○ Implements 20 tuned mass dampers (TMDs) in each of the two towers (to cancel out the sway from wind and to maintain balance). |

**Prompt:** Although located in different parts of the world, both bridges are located in areas that are susceptible to dangerous earthquakes of measurable magnitudes ranging from 8.0 to 9.0 on the Richter scale. In the event of an earthquake, the Interstate 5 Bridge would collapse and cause major damage. However, the Akashi Kaikyo Bridge is highly resistant to natural forces and can withstand wind speeds up to 180 mph and an earthquake with a magnitude of up to 8.5 on the Richter scale.

**Challenge Question:** Explain why the Interstate 5 Bridge collapses from an earthquake with a magnitude of 8.5 on the Richter scale in comparison to the Akashi Kaikyo Bridge (which would not collapse). Provide supporting evidence about each bridge to defend your reasoning.

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[2] Source: Interstate 5 Bridge
[3] Source: Akashi Kaiyo Bridge

Name: __________ANSWER KEY__________________________________ Date: _________________

# Engineering Design Process: *Imagine* Review

**Scenario**: Your friend, Duke, has a hard time getting to school on time. He feels that missing the first 30 minutes of class is putting him behind and causing him to perform poorly on his assignments. He comes to you for advice. His morning routine includes waking up 45 minutes before he has to leave for school. He has to make sure he walks the family dog each morning before he leaves. Since he lives 1.2 miles away from school, he allots 15 minutes to walk to school and stops by the local coffee shop to grab coffee every morning.

**Directions**: Using the scenario above, help Duke find a solution to ensures he makes it to school on time each morning.

1. Identify the problem and generate a problem statement using the correct format.

   <u>Duke needs to find a solution to get to school on time to perform better on his assignments.</u>

2. Generate several alternate solutions for Duke.

   <u>Answers will vary, focus on solution ideas that fulfill his morning requirements and responsibilities.</u>

3. Choose the best solution that fulfills all of the requirements. Explain why you choose your solution.

   <u>Answers will vary, focus on answers that fulfill Duke's requirements and evidence that supports the student's choice.</u>

Name: _________ANSWER KEY_________________________________ Date: ________________

# Introduction to Technical Drawing Worksheet [7]

1. Identify the four major aspects you would find in a technical drawing.

   The geometry, dimensions, text notes and titleblock, and the manufacturing detail.

2. What is the title block? Why is it important?

   The titleblock covers all of the legal information regarding the drawing, company based information, signatures, and approval and organizational information.

3. Why is the manufacturing detail the most important aspect when communicating a design to a manufacturer?

   The manufacturing detail is very important because it lists additional information that's intended for the people who are attempting to manufacture the object that's in the design.

4. What are the two methods for producing a technical drawing?

   Manual drawing method and the CAD software method.

Name: ANSWER KEY Date:
Engineering Partner Name:

# Bridge Design Project: Developmental Work [8-10], [17-23]

**Introduction:** Creating a blueprint drawing of a project design is an important method Engineering. Engineers use technical drawings to effectively communicate and to allow for their design to be presented in a standardized manner that can be understood by all levels within engineering. Technical drawings capture all of the geometric details of a product. This method allows engineers to communicate the precise intent of the drawing as well as allow manufacturers know how to create the parts without the need for additional explanation.

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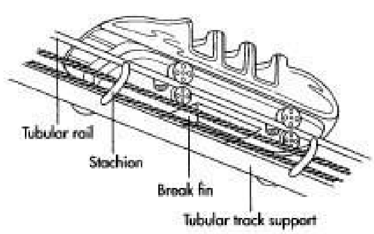
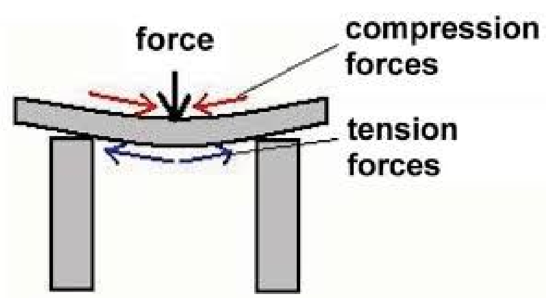
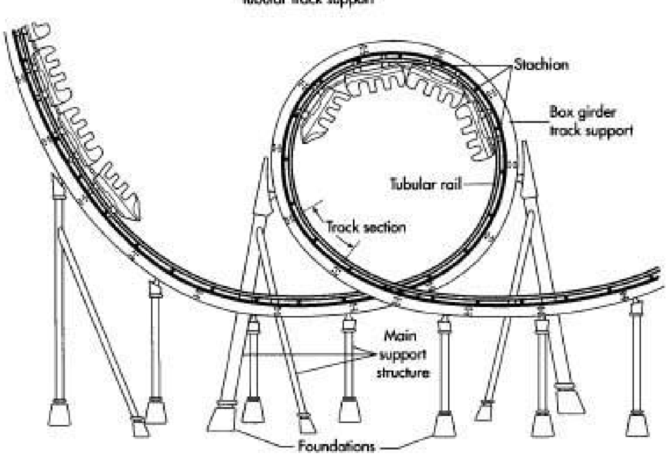
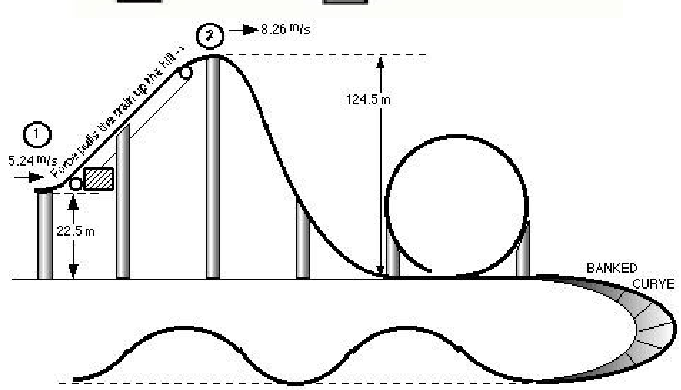


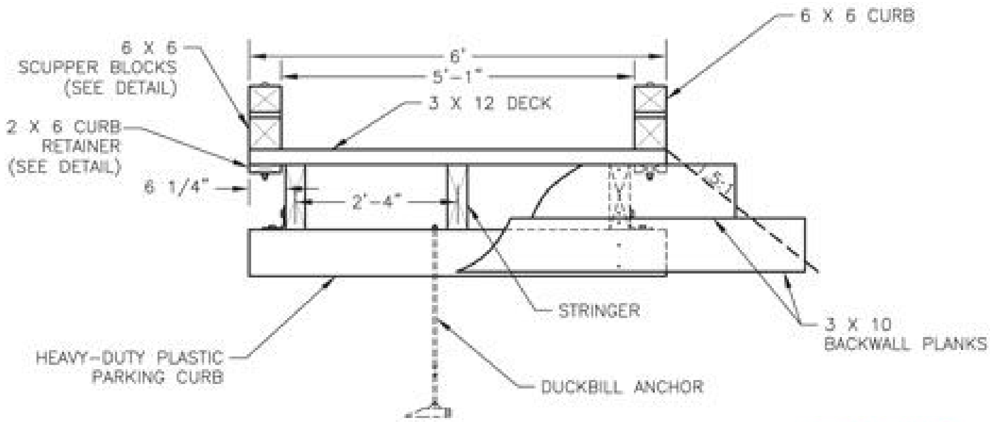



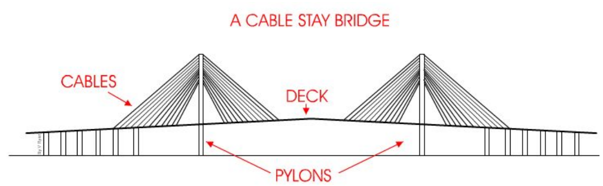



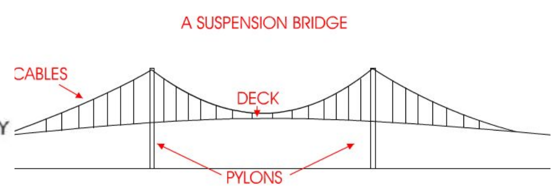
**Directions**: include an overall technical drawing of your bridge showing the geometry and dimensions.

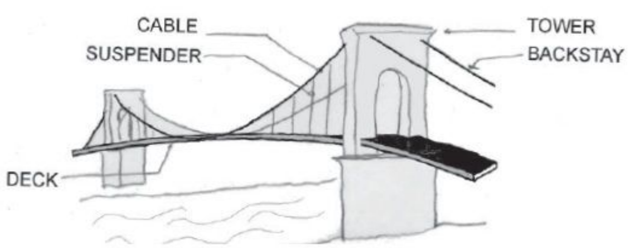
**<u>Student sketches will vary depending on the type of bridge they choose to build. Pay attention to the 30 in. span, and scaling consistency</u>

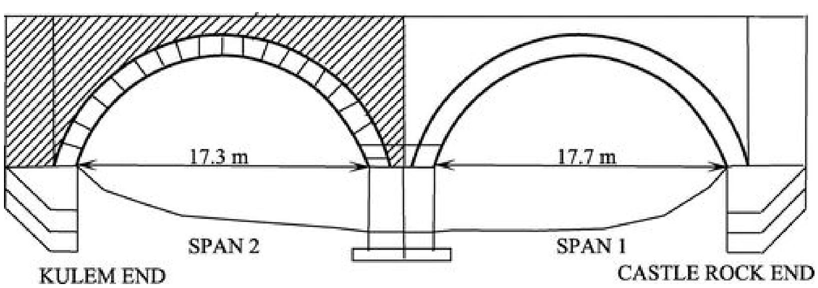
<u>Below are some good examples of the things to look out for as far as the geometry and dimensions of a bridge</u>



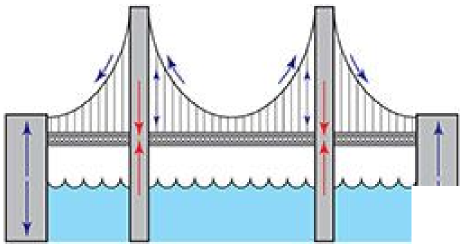



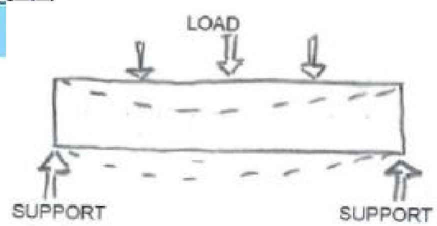



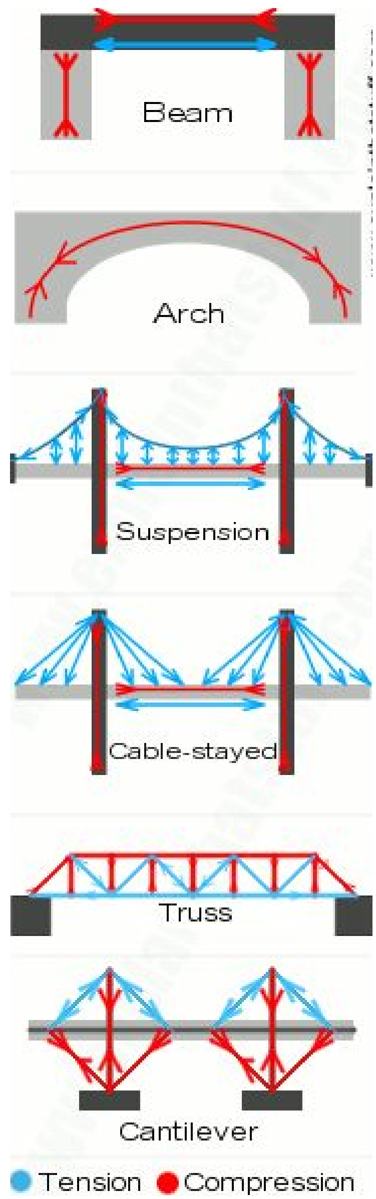
**Directions**: draw how forces act upon your bridge and the tolerances.

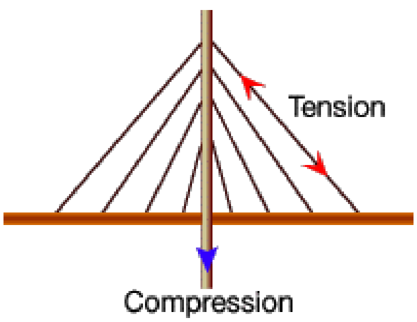
**Student sketches will vary depending on the type of bridge they choose to build. Pay attention to the the way the forces are distributed depending on structure

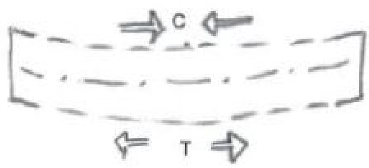
Below are some good examples of force distributions and tolerances on bridges depending on structure.

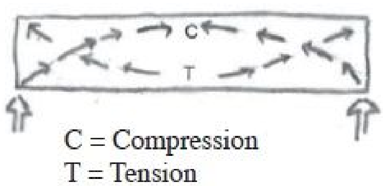


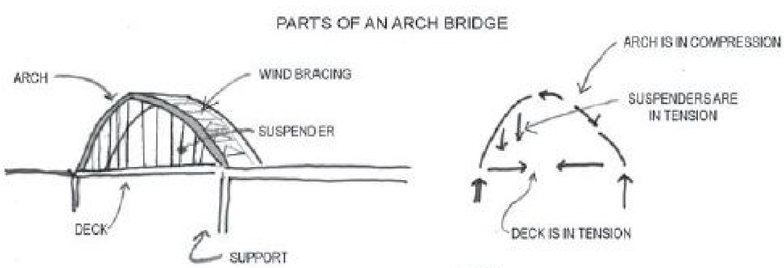


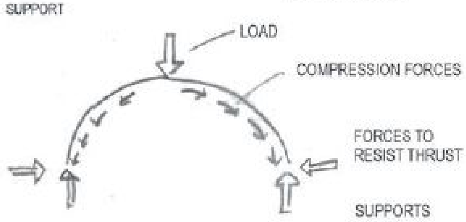



Name: _________ANSWER KEY___________________________ Date: _______________
Engineering Partner Name: ______________________________________________

# Portland, Oregon Bridges Analysis

**Directions:** Read the descriptions of three bridges located in Portland, Oregon. The descriptions contain the necessary information that will lead you to understanding what materials, build structure, and other qualifications that affect the lifespan of a bridge against a strong earthquake. Using the information given in each bridge description, answer the following questions:

1. Rank the bridges in increasing likelihood of collapsing due to an earthquake. Provide supporting evidence about the structures and materials that would degrade from or provide support against an earthquake with a magnitude of 8.0 - 9.0 on the Richter scale.

   Least Likely to collapse: Sellwood Bridge
   Why? The bridge has the lowest chance of collapsing due to the materials used in the piers that support the bridge. The piers allow for flexible movement and would absorb energy released by an earthquake. The approaches have also been reinforced to prevent a landslide, therefore increasing its chance to withstand an earthquake.

   Middle-grade likelihood to collapse: Morrison Bridge
   Why? The bridge has a lower chance of collapsing due to the bridge type. However, due to the concrete material used to construct the approaches, the earthquake may cause the structure to fail as well as the columns.

   Most Likely to collapse: Interstate 5 Bridge
   Why? The bridge has a high chance of collapsing due to the counterweights which would cause the bridge to collapse at several points and break into pieces. The approaches are made of concrete and would liquify due to shaking.

2. Which bridge provided is most similar to your design? Provide detailed evidence.

   **Student responses will vary depending on their bridge design. Focus on the evidence provided and to support their response.

3. If your bridge were to experience an earthquake with a magnitude of 8.0 - 9.0 on the Richter scale, what it your expected outcome? Why? (Be sure to explain the connections of both the structure and the materials of your bridge to withstanding or collapsing from an earthquake).

   **Student responses will vary depending on their bridge design. Students should backup their response with evidence statements about whether the bridge type, structure, and/or materials will withstand a powerful Earthquake.

Name: __________ANSWER KEY____________________________________ Date: __________________

# Exit Ticket: Comparing Bridges [15], [16]

**Directions**: Utilize the Venn Diagram and the prompt to answer the concluding challenge question.

| [4]**Interstate 5 Bridge** | **Similarities** | [5]**Akashi Kaikyo Bridge** |
|---|---|---|
| • **Location:** Portland, OR - Vancouver, WA<br>• **Type:** Truss Bridge with a vertical-lift draw<br>• **Span:** 3538 ft.<br>• **Height:** 230 ft.<br>• **Materials:** Concrete and Steel<br>• **Features:**<br>○ Implements a vertical lift that utilizes concrete counterweights (to maintain the lift-span's weight balances). | • Used as roadways to allow for ships to pass below<br>• Implement a truss design<br>• Use steel as the main material for the bridge structure<br>• Implement a special feature to maintain the balance of the bridge | • **Location:** Kobe, Japan - Awaji-Shima, Japan<br>• **Type:** Suspension bridge with truss support<br>• **Span:** 12,828 ft.<br>• **Height:** 928 ft.<br>• **Materials:** Steel<br>• **Features:**<br>○ Implements 20 tuned mass dampers (TMDs) in each of the two towers (to cancel out the sway from wind and to maintain balance). |

**Prompt:** Although located in different parts of the world, both bridges are located in areas that are susceptible to dangerous earthquakes of measurable magnitudes ranging from 8.0 to 9.0 on the Richter scale. In the event of an earthquake, the Interstate 5 Bridge would collapse and cause major damage. However, the Akashi Kaikyo Bridge is highly resistant to natural forces and can withstand wind speeds up to 180 mph and an earthquake with a magnitude of up to 8.5 on the Richter scale.

**Challenge Question:** Explain why the Interstate 5 Bridge collapses from an earthquake with a magnitude of 8.5 on the Richter scale in comparison to the Akashi Kaikyo Bridge (which would not collapse). Provide supporting evidence about each bridge to defend your reasoning.

The Akashi Kaikyo bridge is able to withstand an earthquake of such high magnitude because it uses a combination of elements that are highly resistant to extreme weather, such as flexible material like steel and a structure design that allows wind to pass though like the truss support. In addition, tuned mass dampers were engineered into the supports of the bridge. These supports act as counterforce to the force produced by high winds and, therefore, maintain balance. Even though the Interstate 5 bridge implements both steel material and a truss design, it would collapse in the event of an earthquake due to the way the lift was designed. The lift uses concrete counter balances that could easily be removed as the main method to maintain balance. These counterweights are not resistant to earthquakes because they can fall due to the rapid shaking in an earthquake. Both bridges allow for ships to pass below, however the Akashi Kaikyo bridge overcame the challenge by designing a taller bridge instead of using the lift design that the Interstate 5 Bridge uses.

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[4] Source: Interstate 5 Bridge
[5] Source: Akashi Kaiyo Bridge

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