

Engineering skills involve asking questions, imagining possibilities, and thinking creatively to solve problems. The engineering design process is a series of steps engineers use as they work to solve problems. There are five main steps:

ASK IMAGINE PLAN CREATE IMPROVE

In the bridge construction project, students will be provided with the “PLAN” for making two different bridge models. Their job will be to **CREATE** the models. Once they finish it is important that they think about ways they could **IMPROVE** the process or the design of the bridges they constructed. This could mean that they would design a **PLAN** and **IMAGINE** their own bridge model.

Bridge Construction Projects



STEAM: Engineering

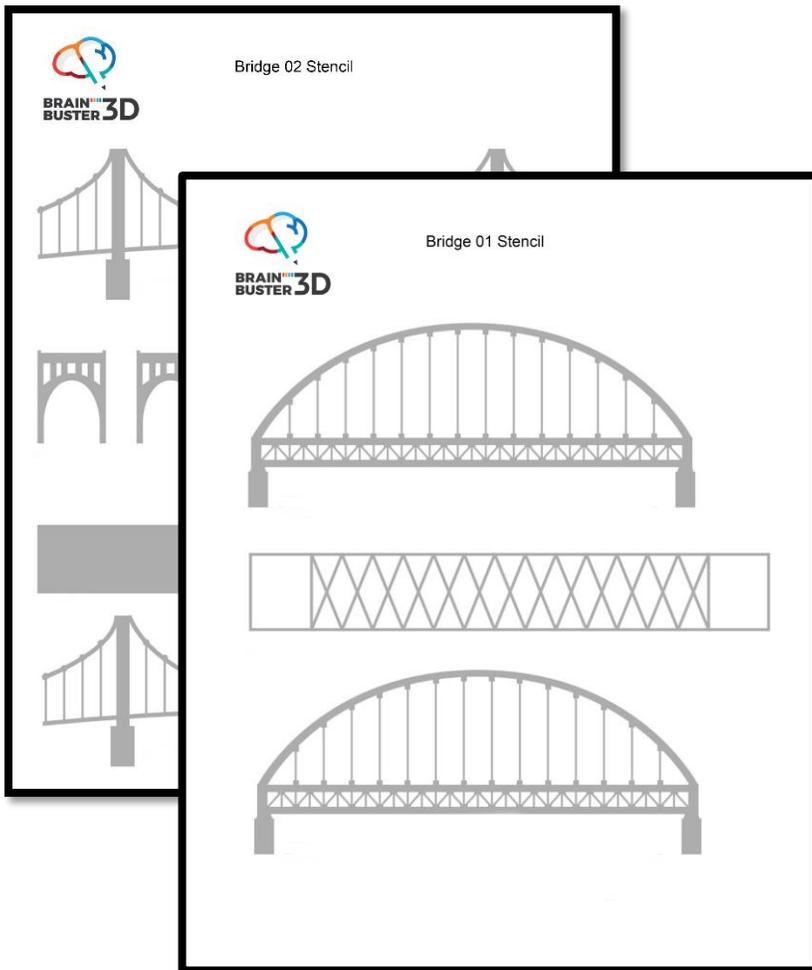
The engineering design process is a series of steps engineers use as they work to solve problems. There are five main engineering steps: **ASK IMAGINE PLAN CREATE IMPROVE**

Constructing Bridges will help students learn Engineering Skills. How?

- They will use a stencil which is their **PLAN** to create each part of the bridge.
- They will need to arrange the parts of the bridge as they would a puzzle, and determine which parts need to be welded together to **CREATE** the 3D form of the bridge.
- When they finish the model, direct students to think about ways they could **IMPROVE** the process or design.
- **ASK** students to **IMAGINE** how they would **PLAN** and **CREATE** their own design for a 3D bridge.

Materials Needed: Bridge 01 & 02 Stencils, 3D Pen, 2-3 colors of PLA filament, scissors, silicon thumb & finger protectors, a paper towel or napkin.

Optional: To keep the stencil intact, place it in a plastic sheet protector.



BRAIN BUSTER 3D Art Pro Plus Kit Contents



AC/DC Adapter & USB



Thumb & Finger Protectors



3 Pack of PLA Filament



Plastic Tool



Art Pro Plus
3D Printing Pen

STEP by STEP INSTRUCTIONS

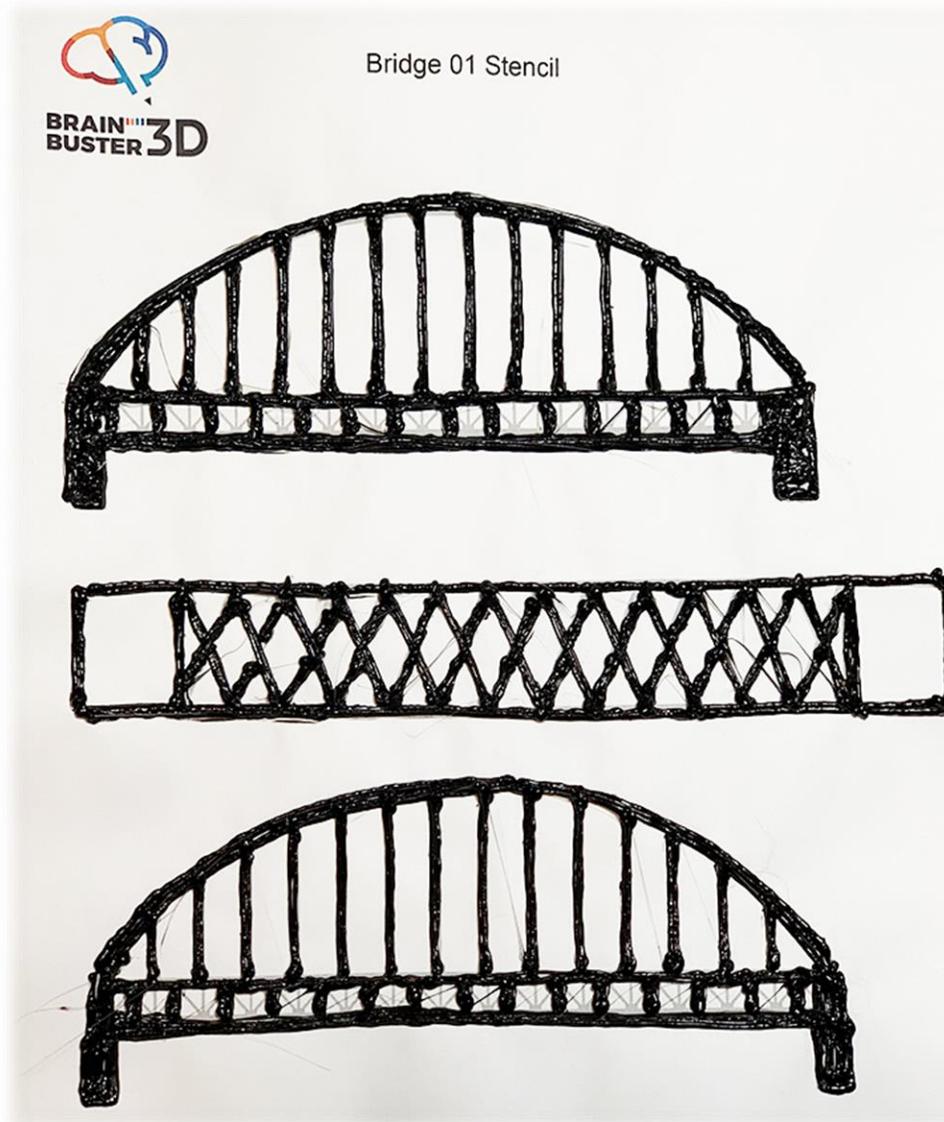
STEP ONE:



Make a copy of the two bridge Stencils 01 and 02. If you need directions about how to operate a 3D pen, please refer to the **Teachers 3D Pen Operators Guide**. Once the 3D pen is heated and loaded with filament, direct students to find a starting point on the stencil to anchor the filament. Then, they will move the 3D pen along the lines to outline each part. Once all the parts are outlined, they will fill in each part by moving the 3D pen back and forth between the outline they made.

They can select any color of filament to create their bridge. If they do not like the PLA filament colors' that they have, they can paint the parts with acrylic paint before they remove them from the stencil or paint their finished bridge model.

STEP TWO:



If students used a plastic sheet protector, the parts should peel off the stencil easily. If they made the parts by extruding the filament directly on the paper stencil, some of the paper will stick to the back of the parts they made. To remove the paper, rinse the plastic parts with warm water and dry them with a paper towel.

STEP THREE:



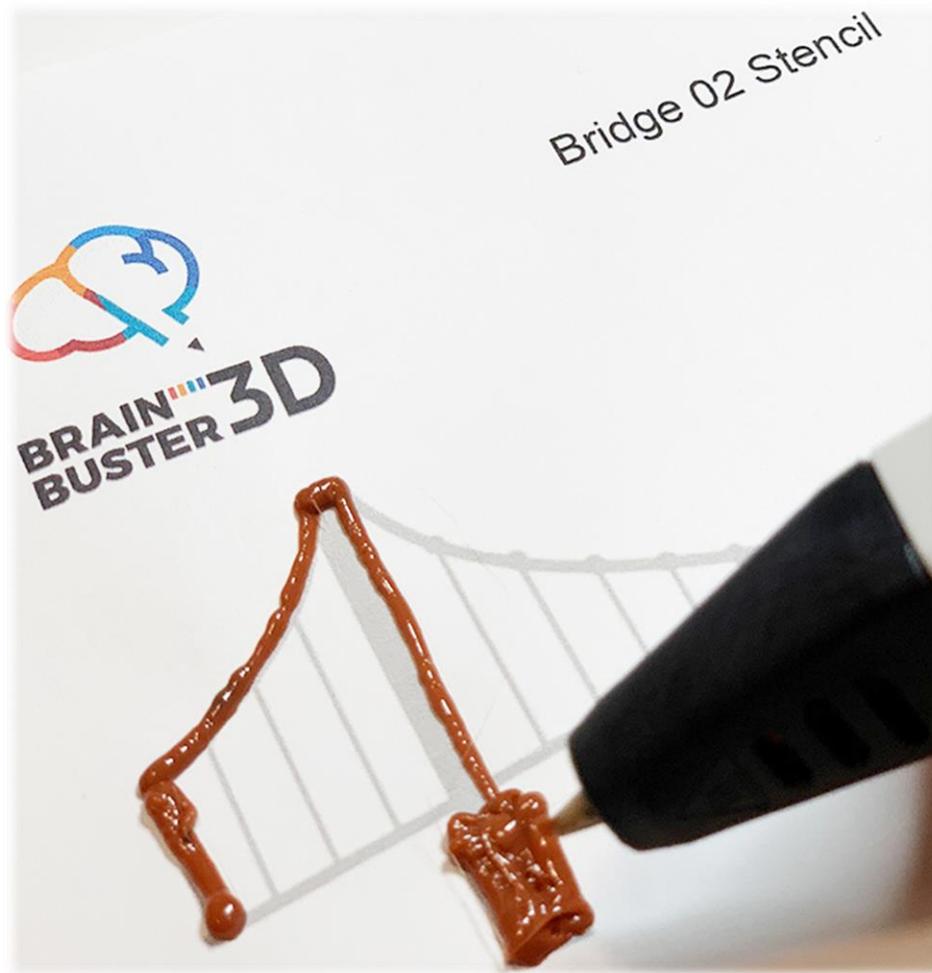
Have students arrange the parts of the bridge as they would a puzzle to see which ones will need to be welded together to form the 3D model.

STEP FOUR:



Have students weld the side of the bridge to the roadway of the bridge edge to edge at 90 degree angles as pictured above.

STEP FIVE:



Direct students to find a starting point on the second bridge stencil to anchor the filament. Move the 3D pen along the lines to outline each part. Once all the parts are outlined, they will fill in each part by moving the 3D pen back and forth between the outline they made.

They can select any color of filament to create their bridge. If they do not like the PLA filament colors' that they have, they can paint the parts with acrylic paint before they remove them from the stencil or paint their finished bridge model.

STEP SIX:



If students used a plastic sheet protector, the parts should peel off the stencil easily. If they made the parts by extruding the filament directly on the paper stencil, some of the paper will stick to the back of the parts they made. To remove the paper, rinse the plastic parts with warm water and dry them with a paper towel.

STEP SEVEN:



Have students arrange the parts of the bridge as they would a puzzle to see which ones will need to be welded together to form the 3D model.

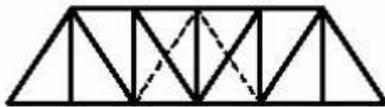
STEP EIGHT:



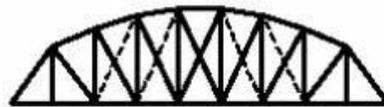
Have students weld the sides of the bridge to the roadway of the bridge edge to edge at 90 degree angles as pictured above.

When they finish the model, direct students to think about ways they could IMPROVE the process or design.

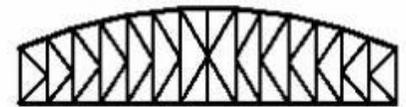
ASK students to IMAGINE how they would PLAN and CREATE their own design for a 3D bridge model. Below are bridge truss designs they could consider when making plans for their next bridge construction project.



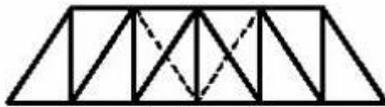
Pratt



Parker



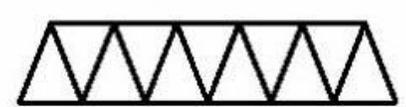
K-Truss



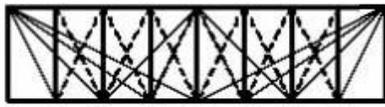
Howe



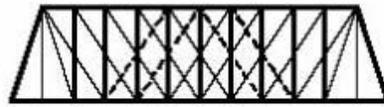
Camelback



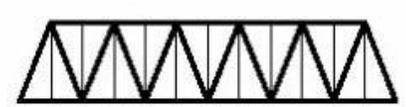
Warren



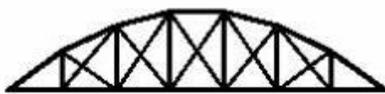
Fink



Double Intersection Pratt



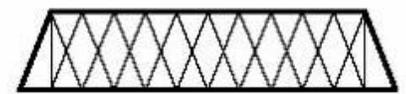
Warren (with Verticals)



Bowstring



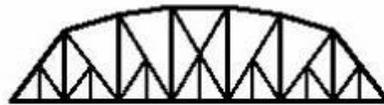
Baltimore



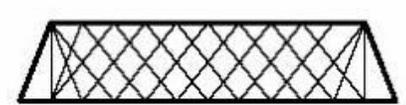
Double Intersection Warren



Waddell "A" Truss

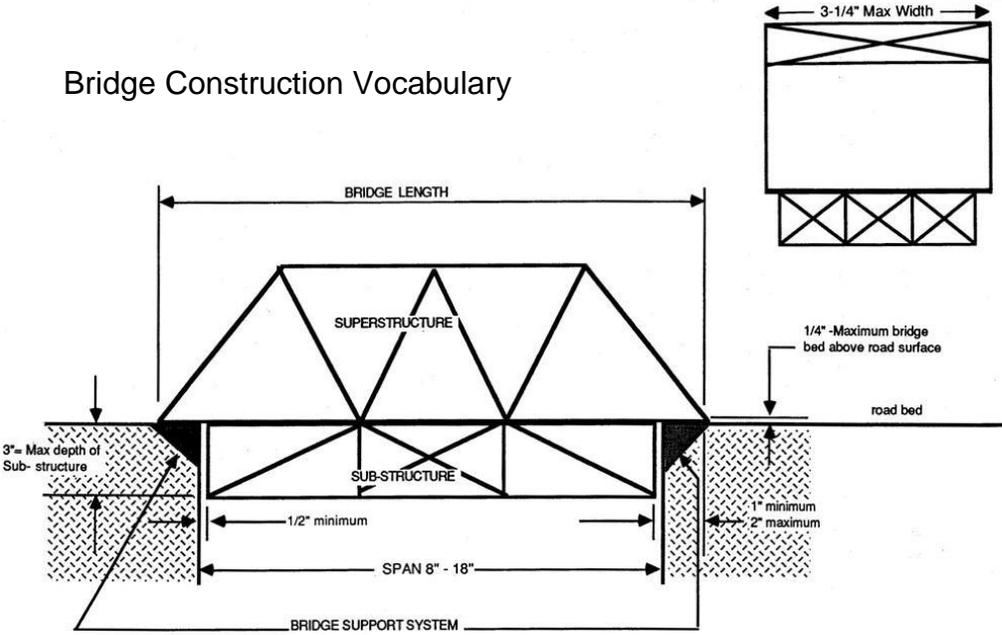


Pennsylvania



Lattice

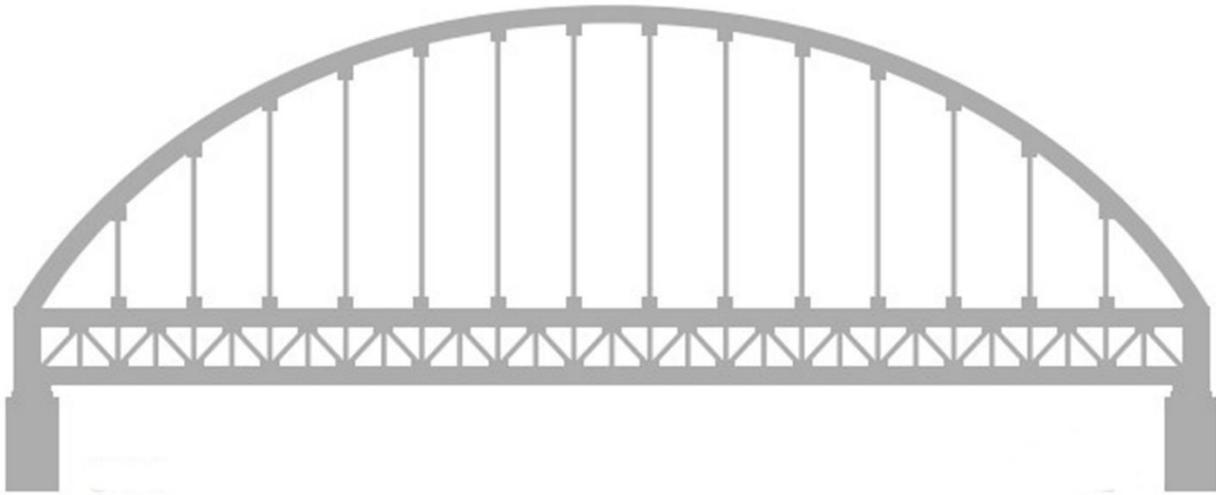
Bridge Construction Vocabulary





**BRAIN
BUSTER 3D**

Bridge 01 Stencil





**BRAIN
BUSTER 3D**

Bridge 02 Stencil

