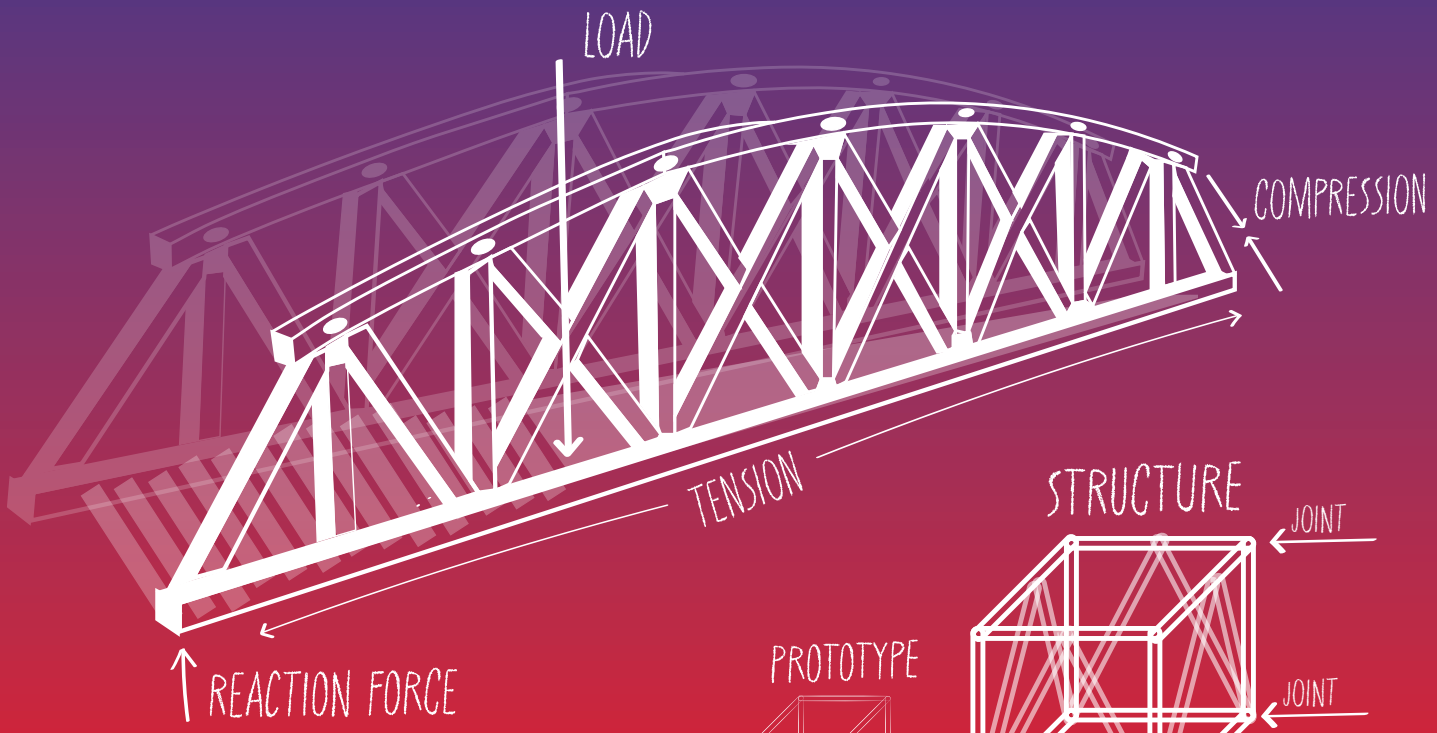
DREAM. BUILD. BECOME.

ACE METAL FOUNDATIONS

By IACMI

Atlas Box Challenge



Atlas Box Challenge

Prior Knowledge

Students should have experience following rules or guidelines while designing or building something. They should be familiar with the idea that designs often need to meet certain requirements, such as using limited materials or supporting weight. Students may have experience planning a design, testing it, and making changes to improve it.

Atlas Box Challenge

Lesson Overview

In this activity, students complete a design challenge that requires them to follow specific rules, called "constraints". Using limited materials, students design and build a box-shaped structure that must support a heavy load placed on top.

Students begin by planning a design that meets the challenge requirements, then build and test a prototype. After observing how their structure performs, students revise their design to improve its ability to hold weight.

Students will explore how the shape of a structure and where materials are placed affect strength, and how testing helps improve designs.

Figure 1: Detailed blueprints used to plan a safe and efficient construction project.

Vocabulary

Constraints: Rules and limits that shape how you design and build

Structure: Something designed to hold its shape and support weight

Prototype: A first version, or rough draft, used to test an idea

Iteration: Making changes based on what you learned from testing

Figure 2: A buidling under construction.

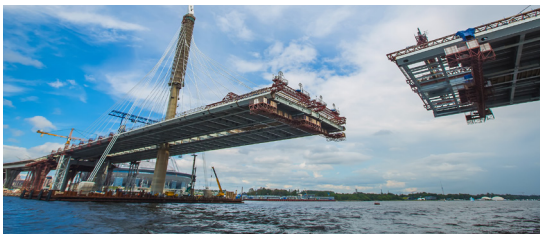


Figure 3: A bridge under construction.

Atlas Box Challenge

The Foundations of Structural Design

A structure is something that is designed to hold its shape and support weight. How a structure is shaped and how its parts are connected both affect how well it can carry a load.

Designers work within limits called constraints, like only using certain materials or meeting size and strength requirements. These constraints influence the choices they make and force them to think carefully about where material is most effective.

When creating a new structure, builders often begin with a prototype, or first version, to test an idea. Testing helps reveal weak spots where a structure may bend, shift, or fail. After testing, designers make targeted changes to improve performance. This process of testing, observing, and making changes is called iteration.

Through iteration, structures can become stronger, more stable, and more efficient—just like in real-world engineering and construction.

You are about to use these ideas in the Atlas Box Challenge. Working in teams of three, you will design and build a box that can support a heavy load using limited materials. After testing your box, you will observe how well it holds up and compare it with designs from other teams in the classroom. If your structure bends, shifts, or collapses, you will have a chance to redesign it and test again. By making careful changes and learning from what you see, you will work to create one of the strongest box designs in the room.

Materials

Materials Supplied in Kit

Per Groups of 3 Students

- 20 to 30 Craft sticks
- 1 roll of masking tape

Materials Supplied by Teacher

- Paper
- Pencil

Atlas Box Challenge

Activity Directions

Step 1: Introduce Constraints

- The structure must be in the shape of a cube
- Students must build their first structure only using 20 craft sticks
- Individual pieces of tape used to connect craft sticks should be no larger than one's thumb
- The strength of an Atlas Box should be tested by placing the same weighted object on top of each box

Step 2: Plan a Prototype

- Working in teams of three, students should use pencil and paper to create a simple sketch of their Atlas Box plan
- Plans should show an understanding of the constraints

Step 3: Build and Test the Prototype

- Students should build their prototype using 20 craft sticks and the constraints from step 1
- Once their box is complete, each structure is tested by placing a heavy load on top, such as a textbook or a pack of computer paper
- Students are encouraged to watch as other groups test their Atlas Boxes to think about what worked, and what did not

Step 4: Iterate and Redesign

- After testing, identify strengths and areas of weakness in the first Atlas Box design
- Based on these observations, teams may redesign their Atlas Box using all 30 of the provided craft sticks in preparation for additional tests

Step 5: Compare Designs and Reflect

- Students should participate in class discussion to note similarities and differences between Atlas Boxes, and how design choices resulted in stronger builds

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Discussion Prompts or Reflection

- Which parts of your structure stayed the most stable during testing?
- Where did your structure bend, shift, or fail first?
- Were there places where adding more material helped?
- How might changing the angles of some craft sticks, rather than keeping them all straight up and down, affect the strength of a box?

Variations and Enrichment

- Constraints can be modified to add complexity or accommodation to this activity
- This activity can be enriched by adding several tiers of loads to bear. Atlas boxes that can bear a textbook might be tested with two textbooks, etc. to compare which designs are able to support heavier loads
- If the class struggles with identifying helpful designs, accommodate by showing images of the structural shapes used in bridges. Make note that many bridges use angled connections to help support their weight

Foundation Exploration

- **Construction Workers and Builders** follow plans and constraints to assemble strong structures. They pay close attention to joints, supports, and stability to make sure structures hold up over time
- **Product Designers** create objects like furniture, storage containers, and packaging that must be strong but efficient. They build prototypes, test them, and redesign to make them better
- **Architects** design spaces that are both useful and safe. They think carefully about shape, materials, and how forces move through structures
- **Structural Engineers** design buildings, bridges, and towers that must support heavy loads while using limited materials. They test designs and make changes to improve strength and safety

Joints