The

STEAM cycle

Phase 1:

Investigation

Research to learn general, overall, information.

Goal: Learn enough to find an interesting topic.

Unit 1:

Living in a Sustainable Future

Overall Science Goals

- Impact on terrestrial and aquatic ecosystems
- Impact of elements and chemicals
- Understand organization of the periodic table
- Electricity production (renewable and non-renewable)
- Use scientific investigation skills
- Career pathways related to food, crop, and sustainable sciences.

Possible Project Ideas

The World's First 3-D Printed School May Soon Be a Reality

Thinking Huts, a nonprofit founded by a 15-year-old, plans to kick off construction in Madagascar

3D model

A Canadian Company Upcycles Millions of Disposable Chopsticks into Sleek Furniture and Home Goods

Built Product

1. Investigation

Research to learn general, overall, information. We are attempting to learn enough to find an interesting topic.

Some Guiding Questions:

- How do humans interrupt natural environmental processes?
- What is sustainability? What are the benefits of sustainability?
- What measures can communities and/or individuals take to help protect the environment?
- In what ways do our individual choices contribute to global issues?
- What is a carbon footprint? How can we calculate a carbon footprint?
- What can we do to improve our communities for the next generation?

1. Investigation

Content Knowledge in Science.

Content Knowledge in Math.

Non-fiction reading about social ethical issues (civics)

Fiction reading about social ethical issues.

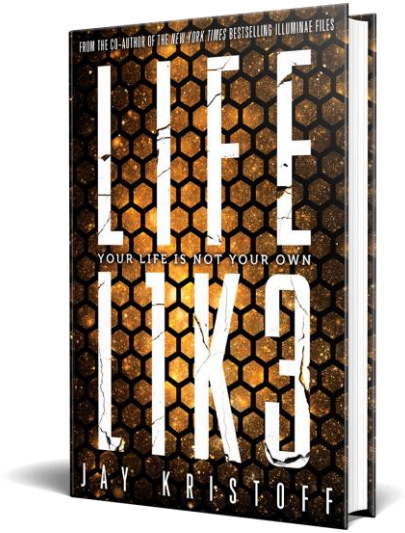
Art critique of engineering AND related art.

English

READING AND LITERATURE STUDIES

1. **Reading for Meaning:** read and demonstrate an understanding of a variety of literary, informational, and graphic texts, using a range of strategies to construct meaning;
2. **Understanding Form and Style:** recognize a variety of text forms, text features, and stylistic elements and demonstrate understanding of how they help communicate meaning;
3. **Reading With Fluency:** use knowledge of words and cueing systems to read fluently;
4. **Reflecting on Skills and Strategies:** reflect on and identify their strengths as readers, areas for improvement, and the strategies they found most helpful before, during, and after reading.

Our goal: to spark an interesting topic in the students.



Dystopian – World of Garbage?

Choose fiction that relates to topic.

Answer formats: 6 Line Questions, Define, MC

Point

Detailed Evidence

Analysis

Short Writing Task

1 Identify an important environmental issue. Use specific details to explain why it is important.

E-waste is an important environmental issue because it is extremely toxic. When people throw electronics in the regular waste, they introduce poisonous substances into landfills. Circuit boards contain lead, tin, and other metals that dissolve into rainwater causing cancer, brain damage and harm to internal organs. The severe health problems caused by the toxins in e-waste makes its improper disposal an important issue.

Phase 2:

Problem Definition

Brainstorming. Lateral thinking. Sketching.

Goal: choose a specific problem they wish to solve.

Specifications List

The problem used below: Use cardboard to build a tower capable of supporting a 100-pound gravity load and a 10-pound lateral load simultaneously. This exercise closely replicates problems faced by real-world skyscraper designers.

Specifications List

1. Tower will only be built out of cardboard and glue.
2. Tower will stand at least 1 m (3 ft) tall.
3. Tower will use minimal amounts of building materials.
4. Tower will support 100 pound gravity load and a 10 pound load simultaneously.
5. Tower will replicate problems faced by and solutions created by real-world skyscraper designers.

2. Problem Definition

Brainstorm ideas.

Skills development: writing, art, safety, tech.

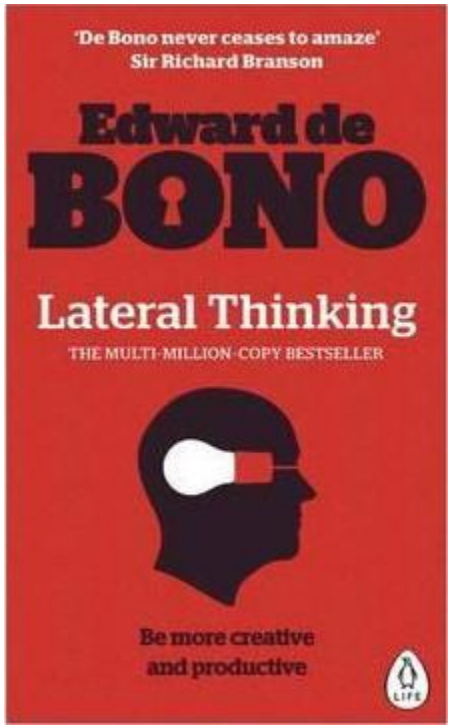
Choose a problem.

Tech

Science

We need to employ a series of brainstorming techniques to generate an ideas list.

Brainstorming is an active process.



Random entry idea generation

The thinker chooses an object at random, or a noun from a dictionary and associates it with the area they are thinking about. De Bono exemplifies this through the randomly-chosen word, "nose", being applied to an office photocopier, leading to the idea that the copier could produce a lavender smell when it was low on paper.

Provocation idea generation

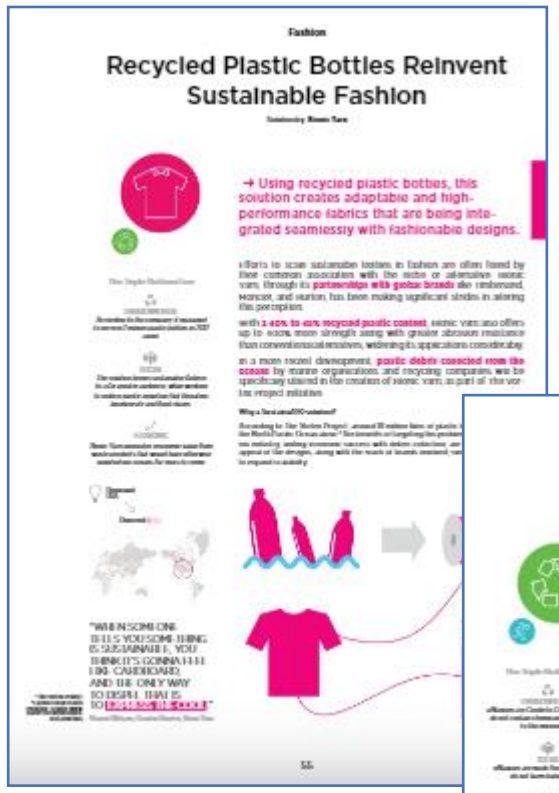
A provocation is a statement that we know is wrong or impossible but used to create new ideas. De Bono gives an example of considering river pollution and setting up the provocation, "the factory is downstream of itself", causing a factory to be forced to take its water input from a point downstream of its output, an idea which later became law in some countries. Provocations can be set up by the use of any of the provocation techniques—wishful thinking, exaggeration, reversal, escape, distortion, or arising. The thinker creates a list of provocations and then uses the most outlandish ones to move their thinking forward to new ideas.

2. Problem Definition

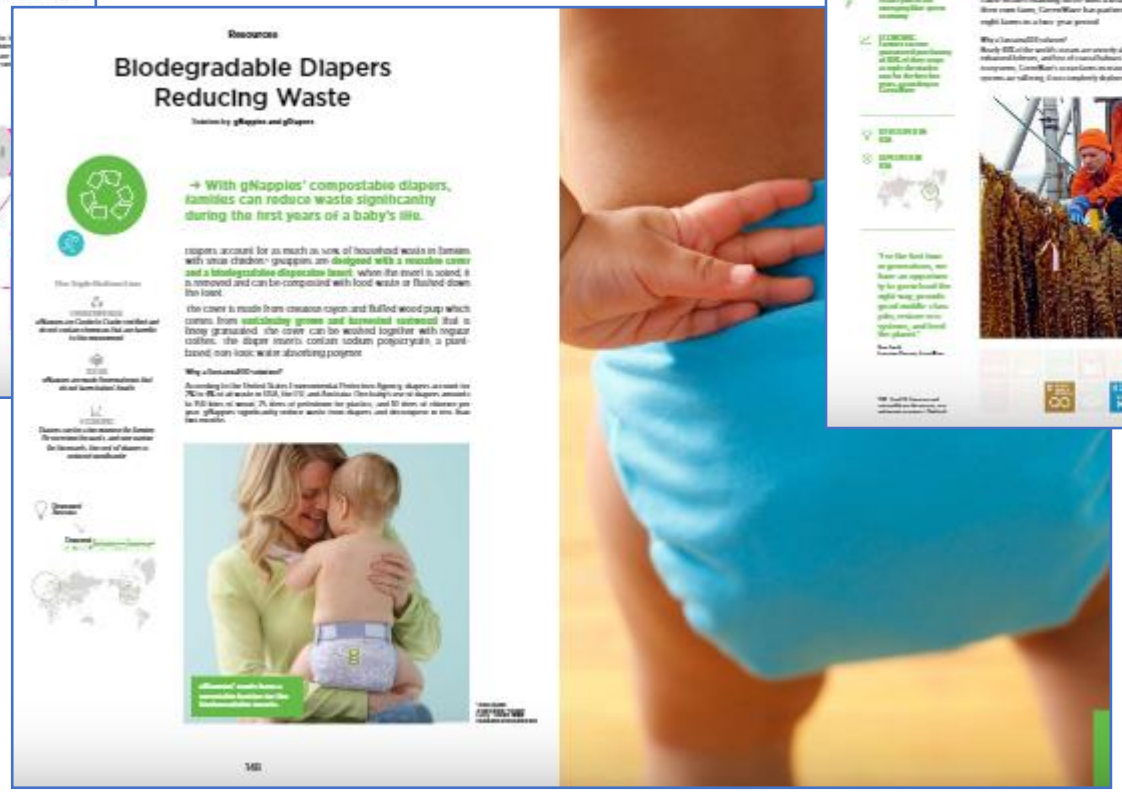
Brainstorm ideas.

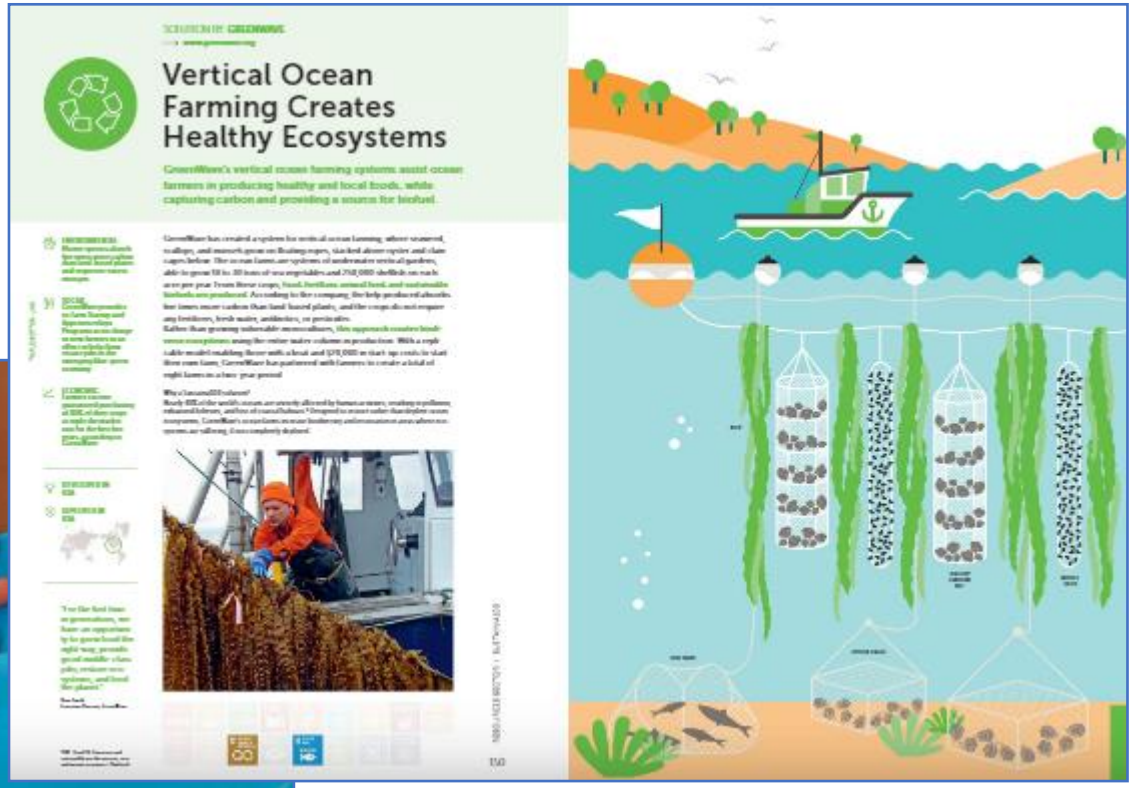
Skills development: writing, art, safety, tech.

Choose a problem.



Take your three problems, pick one.





6 liner to justify choice. 2 more to justify not picking others.

2. Problem Definition

Brainstorm ideas.

Skills development: writing, art, safety, tech.

Choose a problem.

English

Civics

Tech

Science

Art

Students will take their three best ideas and make three elevator pitches.

Based on Define/ Significance.

Filmed.

30 seconds.

Oral mark.

Phase 3:

Analysis

Brainstorm solutions, experiment with prototypes, sketch ideas to solve problem.

Further research into specific topics.

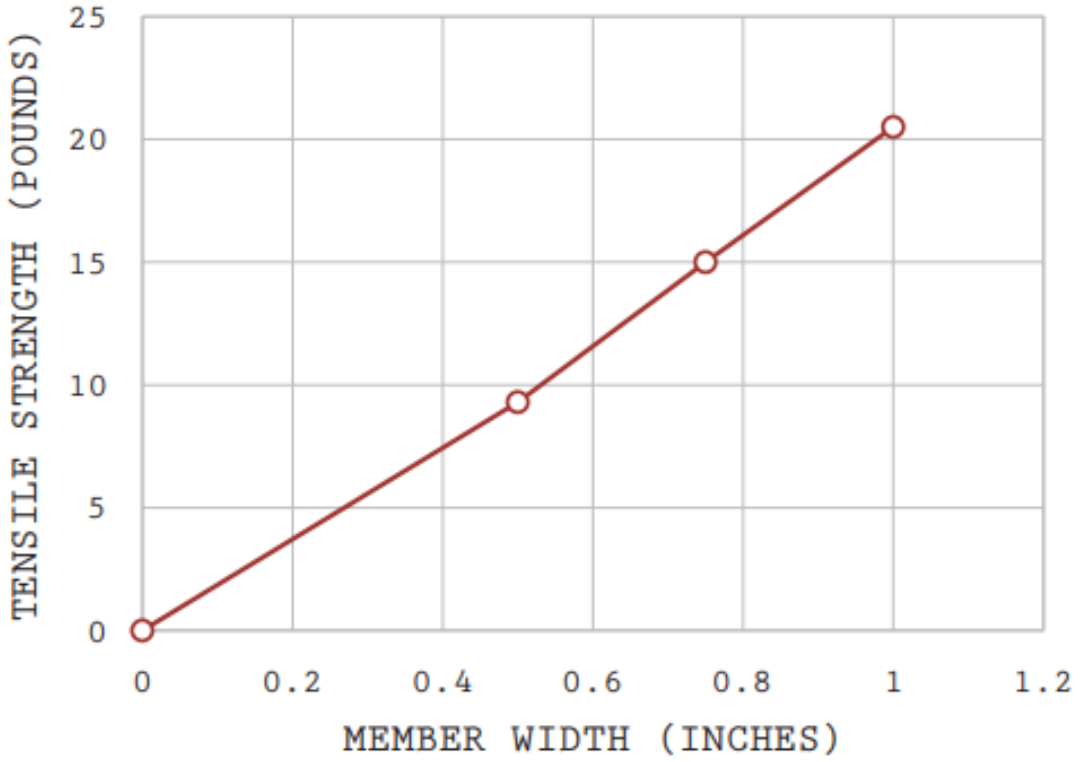
Create a specifications list.

Goal: Develop possible solutions.

The RRS might contain experiments to learn about design constraints.

Experimental Determination of Tensile Strength

The tensile strength of file-folder cardboard has been determined experimentally by using a lever-based testing machine to load cardboard specimens of various widths until they rupture. Drawings and a materials list for the testing machine are provided in appendix A. Use of this machine is demonstrated in lesson 3. Results of the tests are shown in the graph of tensile strength versus member width below.



3. Analysis

Further research into their specific topic. Create a list of specifications (success criteria) for their project.

Research more into topic.	Create specifications List.	Content Knowledge in Science.	Content Knowledge in Math.	Skills development: writing, art, safety, tech.

Some Guiding Questions

- How do we improve environmental aspects in design when cost becomes a factor?
- Do governments and individuals have equal responsibility to protect the environment?
- How can designers balance the needs of the environment with the needs of stakeholders?
- What are environmentally conscious building techniques?
- How can we create a 3D model?

Phase 4:

Design

Evaluate solutions, choose one.
Draw or build prototypes.
Generate Materials list. Layout artistic design.
Goal: Create model of solution.

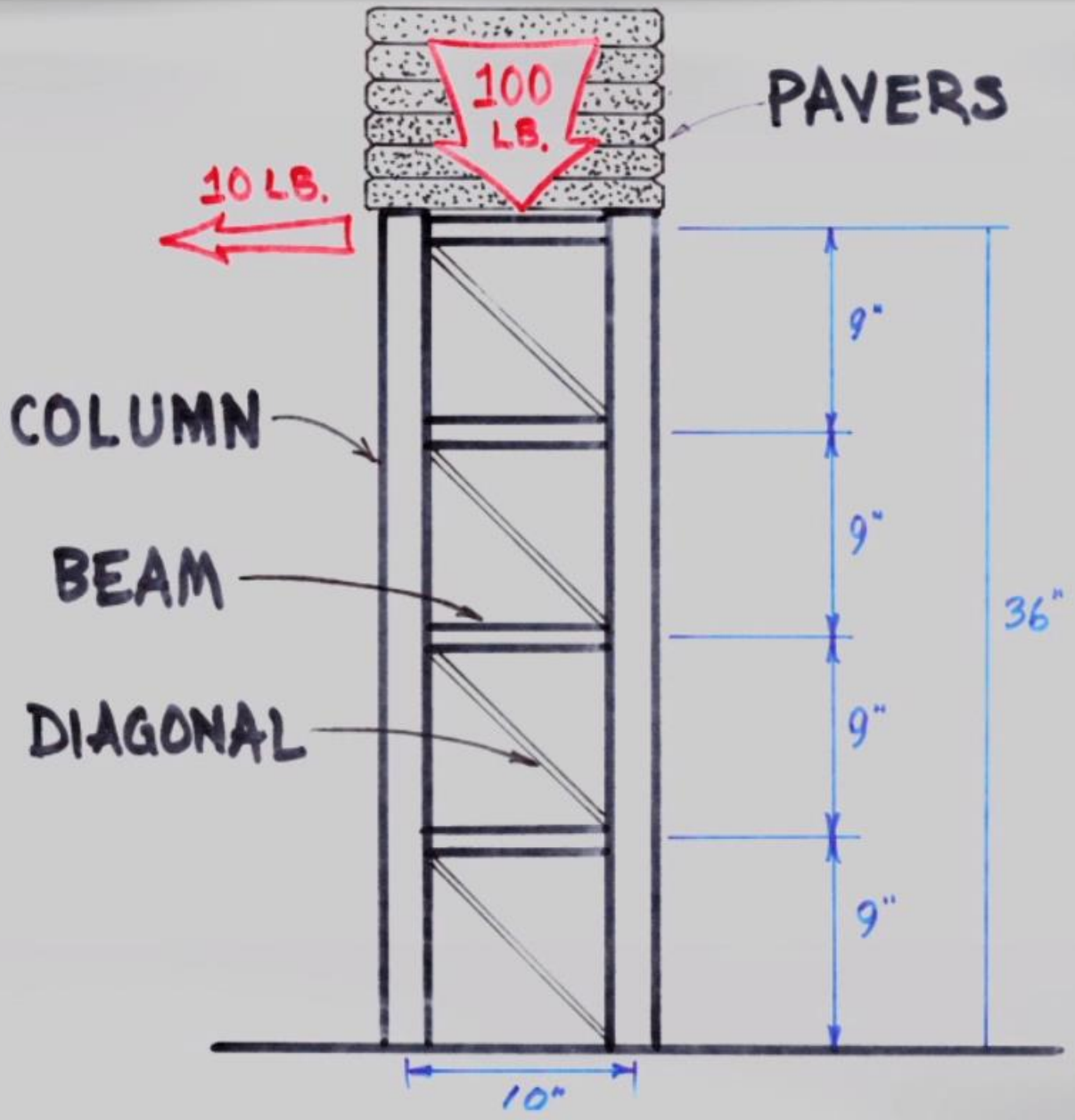
MATERIALS LIST

NAME	DESCRIPTION
Column (8)	1″ × 1″ × 18″ corrugated cardboard tube formed around a ¾″ × ¾″ core
Beam (16)	1″ × ½″ × 8¾″ corrugated cardboard tube formed around a ¾″ × ¼″ core
Diagonal (48)	5⁄16″ × 13⅝″ manila file-folder cardboard
Gusset plate A (12)	See full-size template.
Gusset plate B (12)	See full-size template.
Gusset plate C (36)	See full-size template.
Connecting plates (32)	See full-size template.
Lower footing (8)	2″ × 2″ corrugated cardboard
Upper footing (8)	¾″ × ¾″ corrugated cardboard
Base	14″ × 14″ × ¾″ plywood or MDF

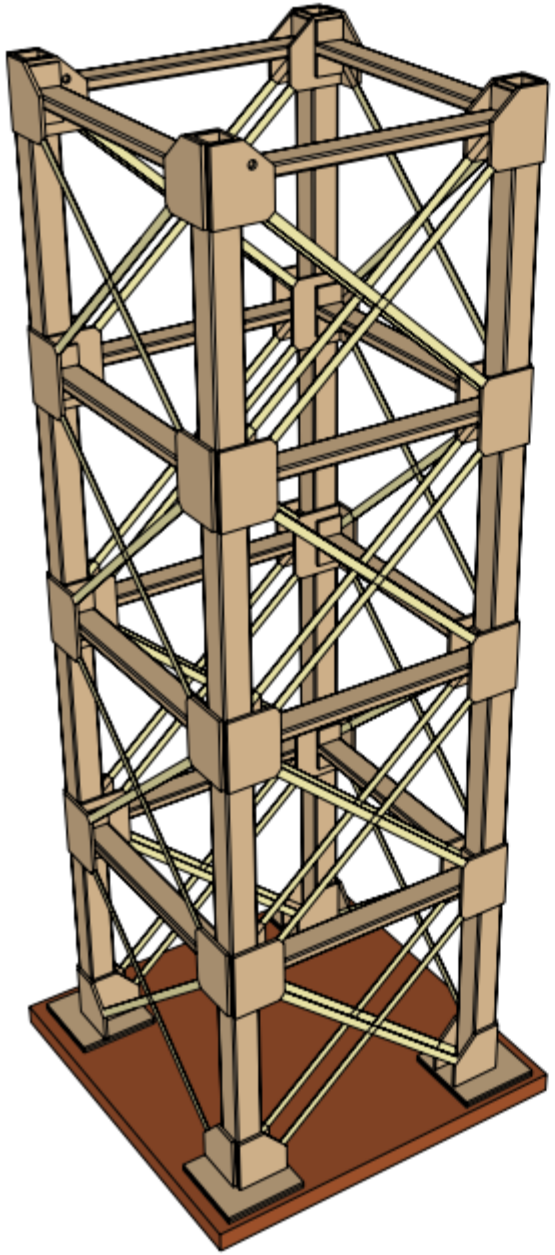
The following supplies and tools are used to construct the tower:

- one 18″ cardboard moving carton
- one legal-size file folder
- wooden base
- wood glue
- wax paper
- sewing pins
- ¾″ × ¾″ metal or wooden core for forming columns
- ¾″ × ¼″ metal or wooden core for forming beams
- scrap wood for tube-forming jig
- hobby knife or single-edge razor blade
- scissors
- clamps
- weights (to be used as clamps)

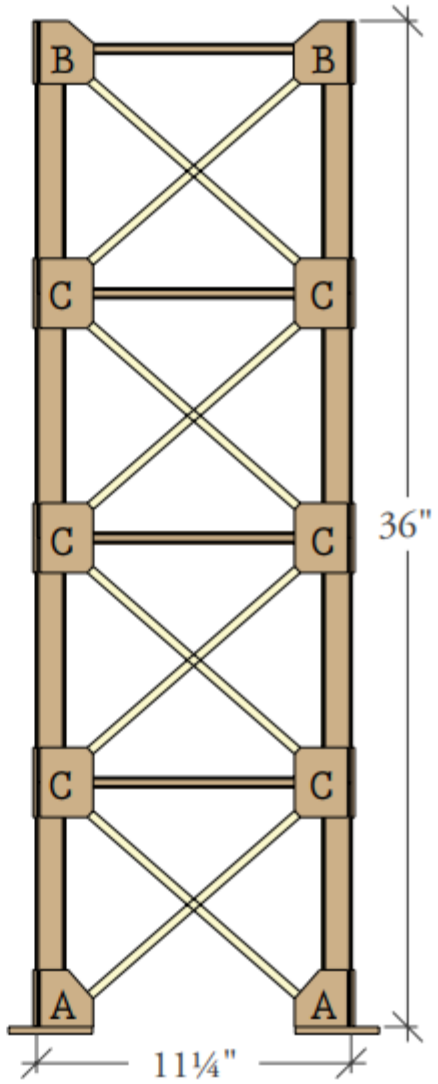
The RRS might contain design drawings



Drawing 2.1 » Tower perspective view



Drawing 2.2 » Tower elevation view, showing three gusset-plate designations



The RRS might contain designs in Sketch-up

Phase 5:

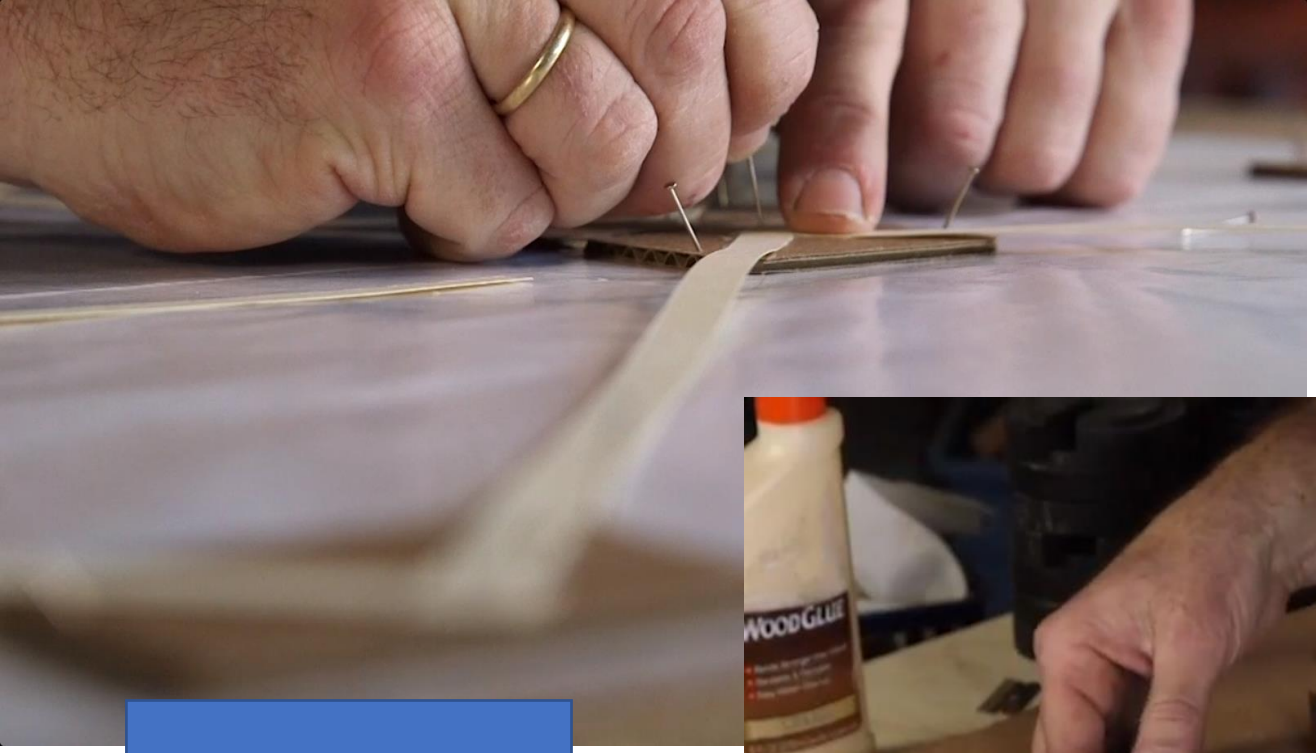
Creation

Build final product.

Apply and demonstrate skills. Edit work carefully.

Goal: Create fully complete solution to problem.


The RRS might contain process photographs



The RRS might contain process photographs


The RRS might contain process photographs

Phase 6:

Testing

Alpha testing, Beta testing. Peer testing. Proof reading. Test against specifications. Goal: Fully test final product.


The RRS might contain evidence of testing
PAVERS

Phase 7:

Reflection

Evaluate solution.

Present solution to others.

Goal: Understanding of successes and creation of future goals for improvement.

The STEAM Cycle

1. Investigation
2. Problem Definition
3. Analysis
4. Design
5. Creation
6. Testing
7. Reflection

IPADCTR

The acronym.

Pronounced: iPAD-Ki-TeR

1. Investigation

White Board Brainstorming
School Tour

2. Problem Definition

Research Question (typed)
Justification Paragraph (typed)
Rough Thumbnail

3. Analysis

Solution Proposal (typed)
White Board Thumbnail
Variables (typed)

4. Design

Detailed Thumbnail
Materials List
Detailed To-Do List, Divided

4. Design

Detailed Thumbnail
Materials List
Detailed To-Do List, Divided
Survey

5. Creation

Product (Link, Model…)
At least 5 pictures of product

6. Testing

Survey
Alpha Testing
Beta Testing

7. Reflection

Newspaper Article
Reflection