# THE CARDBOARD CHAIR CHALLENGE (GRADE 7)

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In this project, students will apply their understanding of the structures unit to create a piece of cardboard furniture that is designed to suit the needs of a member of your school community.

**Grade Level/Course Code:** Grade 7 Science and Technology

**Strand and Unit:** Understanding Structures and Mechanisms: Form and Function

**Inquiry Focus:**

*How might you design a piece of cardboard furniture to suit the needs of a user?*

**Timeline:**

This project should take 3-4 weeks to complete in full.

In the past I have provided 4-5 75 minute lessons to build the full-size prototypes, though some students have requested extra time to work outside of lessons.

If teaching Science and Technology as a rotary subject, the timeline may become stretched. The project would be well suited to run cross-curricularly, between multiple rotary or home room teachers. This would also help to condense the timeline.

Variables that might affect the timeline include:

- Scheduling with other members of the community, time to teach safety procedures, research time, time for completion of student work, etc

**Big Ideas**:

**Science and Technology**

- Structures have a purpose.
- The form of a structure is dependent on its function.
- The interaction between structures and forces is predictable.

**Overall Expectations:**

**Science and Technology**

- Analyse personal, social, economic, and environmental factors that need to be considered in designing and building structures and devices;
- Design and construct a variety of structures, and investigate the relationship between the design and function of these structures and the forces that act on them;
- Demonstrate an understanding of the relationship between structural forms and the forces that act on and within them.

**Language Arts**

- Use speaking skills and strategies appropriately to communicate with different audiences for a variety of purposes;
- Create a variety of media texts for different purposes and audiences, using appropriate forms, conventions, and techniques.

**Mathematics**

- Report on research into real-life applications of area measurements.

**Specific Expectations:**

**Science and Technology**

**1.1** - evaluate the importance for individuals, society, the economy, and the environment of factors that should be considered in designing and building structures and devices to meet specific needs

**2.1** - follow established safety procedures for using tools and handling materials

**2.3** - investigate the factors that determine the ability of a structure to support a load

**2.6** - use appropriate science and technology vocabulary, (including truss, beam, ergonomics, shear, and torsion), in oral and written communication

**2.7** - use a variety of forms (e.g., oral, written, graphic, multimedia) to communicate with different audiences and for a variety of purposes

**3.2** - describe ways in which the centre of gravity of a structure affects the structure's stability

**3.3** - identify the magnitude, direction, point of application, and plane of application of the forces applied to a structure

**3.4** - distinguish between external forces and internal forces acting on a structure

**3.5** - describe the role of symmetry in structures

**3.7** - identify the factors that determine the suitability of materials for use in manufacturing a product

**Language Arts**

**2.3 -** communicate orally in a clear, coherent manner, using a structure and style appropriate to both the topic and the intended audience

**2.4 -** use appropriate words, phrases, and terminology from the full range of their vocabulary, including inclusive and non-discriminatory language, and a range of stylistic devices, to communicate their meaning accurately and engage the interest of their intended audience

**3.4 -** produce a variety of media texts of some technical complexity for specific purposes and audiences, using appropriate forms, conventions, and techniques

**Mathematics**

(Depending on which areas of the project you focus on, the following areas of the curriculum could be included)

***Number Sense and Numeration***

- select and justify the most appropriate representation of a quantity (i.e., fraction, decimal, percent) for a given context

- solve multi-step problems arising from real-life contexts and involving whole numbers and decimals, using a variety of tools (e.g., concrete materials, drawings, calculators) and strategies (e.g., estimation, algorithms)

***Measurement***

- research and report on real-life applications of area measurements.

- solve problems that require conversion between metric units of measure (e.g., millimetres and centimetres, grams and kilograms, millilitres and litres)

This project can also be used to address the Mathematical Process Expectations, as outlined in the curriculum document.

**Key Concepts**:

- How to design a structure to meet the specific needs of a user
- The importance of proper lab safety and how to protect faces and feet from falling objects
- Function informs form
- How to use the engineering design process to address a need and create a solution

**Prior Skill Sets:**

- Measuring
- Cutting (proper cardboard cutting technique will be covered through the project, however)
- Taping, glueing

**Prior Knowledge:**

- What is a chair? How is it designed/built?
- What is the definition of aesthetics?
- Students should have knowledge of the following concepts:
    - Internal and external forces
    - Centre of gravity and stability
    - Factors that affect the stability of a structure (beams, trusses, arches, domes, etc)
    - Reasons for structural failure
    - The product development process
    - Symmetry in form and function
    - Ergonomics

**Materials and Equipment:**

- Cardboard (can be purchased new or you can use recycled material)
- Cardstock (is easier to use when creating scale prototypes)
- Masking tape
- Hot glue guns and glue sticks
- Utility knives
- Cutting boards
- Rulers, metre sticks

- Measuring tapes
- Computers for internet research and word processing

**Safety:**

- Wear safety goggles when cutting or gluing
- Have students watch the safety video series about proper cutting technique before performing any cutting on their own

  http://designed.mit.edu/design-online/foamcore.html (http://designed.mit.edu/design-online/foamcore.html)

  http://designed.mit.edu/design-online/cardboard.html (http://designed.mit.edu/design-online/cardboard.html)

- Alternatively, access the videos via Josh Ramos' Youtube channel

  https://www.youtube.com/user/joshramos1/videos (https://www.youtube.com/user/joshramos1/videos)

- Remind students to be safe when using hot glue guns

**Instructional Planning and Delivery:**

Before beginning the project with your class, approach a member of your school community who will act as the user for the class. Find someone who needs a new chair for their classroom, and the students will create that chair for them. The user will then be able to provide feedback to the students about their designs. Complete the **Needs Survey**.

It would also be an excellent idea to reach out to members of your community to find someone who has expertise in furniture design, industrial design, engineering, or any construction field. This would help the students find authenticity in the project by showing real world connections and lending an expert voice to the design process. Alternatively, you could use the Skype in the Classroom program to find an expert in the field to speak with over Skype. https://education.microsoft.com/skype-in-the-classroom/find-guest-speakers (https://education.microsoft.com/skype-in-the-classroom/find-guest-speakers)

Throughout the project, the students will complete a number of assessed journal entries, in a variety of formats. This will provide an opportunity for reflection and self-assessment, as well as an assessment opportunity for you. Use these provided journal outlines.

As the students work through the project, they may find it useful to use a program like Google Keep or Trello to organize their group as they complete multiple pieces of work. (Trello does require you to create an account).

An example of how you might use a Trello board (https://trello.com/b/Le6hF0OH/cardboard-chair-challenge-example).

*15 Ways for Students to Use Google Keep* (https://shakeuplearning.com/blog/15-ways-students-use-google-keep-infographic/)

If students are using an online organizational tool, they should upload screenshots to accompany each journal entry, chronicling their ongoing work.

Through the course of the project the students will submit a number of deliverables, which should be assessed as and for learning, and will direct the project work.

**Mid-Project Deliverables:**

- Independent research assignment
- Group Great Chair Search document
- Group concept sketches
- Group scale prototype
- Group User Feedback document

At the end of the project the students will submit three deliverables and should make presentations to the class and the designated user, in groups. The presentations should highlight the process through which the chairs were designed and built, and identify how the design meets the needs of the user. The user should then provide final feedback, identifying the chair that they feel best suits their needs.

**Final Deliverables:**

- Group chair (the final, full-size, prototype)
- Independent journal entries
- Independent infographic/poster outlining the specs of their chair and the process through which it was created

**Timeline**

| Lesson | Activities | Checkpoints |
|---|---|---|
| 1 | The Engineering Design Process | Complete the cut and paste activity about the Engineering Design Process from the We Made It website (https://www.wemadeit.ca/lesson/grade-7-engineering-design-process/) |
| | | Students will complete the independent research assignment |
| | Introduce project, assign independent research assignment | Throughout the project, the students will complete multiple journal entries |

Here are some links to websites about the process of designing a chair:

- UMBRA Oh Chair video (https://www.youtube.com/watch?v=nkgaBzbAfl4)
- IKEA Design Process video (https://www.youtube.com/watch?v=jU-imkEarvU)
- Chair Institute's History of the Chair (https://chairinstitute.com/history-of-the-chair/)

| | | |
|---|---|---|
| 2 | Measurement activity (the Great Chair Search) | Assign groups<br>Complete the **Great Chair Search** |
| | Discussion about what makes a chair comfortable and aesthetically pleasing | Create a template for suggested measurements for the chair as a class |
| 3 | Introduce needs of community member | Provide the students with a completed **Needs Survey** |
| | Prototype designing | Using information from the Great Chair Search and their independent research assignments, students will begin to prototype some designs that might fit their user's needs |
| 4 | Design analysis<br>(this should be done between groups, with feedback given from peers) | Complete 3-5 concept sketches<br>Identify any structural elements in their designs from the unit - beams, trusses, arches, domes, cantilevers, etc. |

| | | |
|---|---|---|
| 5 | Final design chosen, cardboard prototype built | Combine elements from each design to create your final design. Build a scale prototype from cardboard or cardstock |
| 6 | Feedback from user | Students will pitch their design to the user, and create a survey to gather information about how to move forward with their full-size prototype<br><br>**User Feedback** |
| 7 * | Chair building<br><br>*This will occur over multiple lessons*<br><br>*Be sure to set clear guidelines for time* | Decide with the class how long they will have to create their full-size prototype<br><br>Review safety procedures<br><br>http://designed.mit.edu/design-online/foamcore.html (http://designed.mit.edu/design-online/foamcore.html)<br><br>http://designed.mit.edu/design-online/cardboard.html (http://designed.mit.edu/design-online/cardboard.html) |
| 8 | Final prototypes completed | Students will complete their full-size prototypes, to be presented to the class and the user. |
| 9 | Presentations in class / Final pitch to user | Students present their final, full-size, prototypes to the class, briefly explaining the process through which they created the chair, and how their design meets the needs of the user.<br><br>The user should then provide final feedback on each of the designs, and suggest which design they feel best suits their needs.<br><br>**Poster/Infographic Outline**<br><br>**Infographic Examples**<br><br>**Student Examples** |

**Student Support Resources:**

**Activity 0 - Pre-Activity - Needs Survey**

**Activity 1 - Independent Research Assignment**

**Activity 2 - Great Chair Search**

**Activity 3 - Concept Sketches**

**Activity 4 - User Feedback**

**Activity 5 - Independent Poster/Infographic**

**Student Project Outline**

**Independent Journal Entry Outlines**

**Related Background Resources and/or Links:**

**Engineering Design Process**

We Made It (https://www.wemadeit.ca/lesson/grade-7-engineering-design-process/)

- The We Made It website has created a nice resource that organizes the Engineering Design Process into 4 clear steps. I like to use this to guide and direct my students
- Activity 1 in this pack is an excellent cut and paste activity to help your students discover the steps of the process

*You will need to create an account on the We Made It site to access the documents.*

**Chair Design**

UMBRA Oh Chair video (https://www.youtube.com/watch?v=nkgaBzbAfl4)

IKEA Design Process video (https://www.youtube.com/watch?v=jU-imkEarvU)

Chair Institute's History of the Chair (https://chairinstitute.com/history-of-the-chair/)

**Relevant Readings**

*15 Ways for Students to Use Google Keep* (https://shakeuplearning.com/blog/15-ways-students-use-google-keep-infographic/)

*Reflective Journal Writing as an Alternative Assessment*
(http://www.otterbein.edu/Files/pdf/Education/JTIR/VolumeIII/williams.pdf)

*The Importance of Student Journals* (https://www.edutopia.org/blog/student-journals-efficient-teacher-responses)

**Assessment Opportunities:**

**Journal Entries:**

By having the students produce journal entries throughout the project, you provide an opportunity for Assessment as Learning through self-assessment and reflection. The journals also allow for teacher feedback during the process.

**Journals Assessment**

**Independent Research:**

The independent research assignment provides an Assessment as Learning opportunity, where you can highlight for the student where they have done good research, and where they may need to do some further research to guide their project work.

**Independent Research Rubric**

**User Feedback:**

By surveying the user about their needs and then asking for feedback on proposed designs, the students are using Assessment as Learning, and should be able to adjust their design work accordingly from that feedback.

**User Feedback**

**Final Chair Design:**

The final chair design will be a piece for Assessment of Learning.

**Final Chair Assessment**

**Poster/Infographic:**

The independent poster/infographic will provide an opportunity for each student to highlight their personal contributions to the project and their own understanding of the application of the relevant Science. This is Assessment of Learning.

**Poster/Infographic Assessment**

**Future Opportunities / Extensions / Modifications:**

There are many possible ways to extend or modify this project. Some of which may include:

- To allow for greater student voice and choice, you could have the students approach members of the school community at the outset of the project, and complete the initial user surveys on their own

***Extensions***

- You could extend the portion of the project that addresses the Math curriculum, creating a smaller project just out of those criteria
- You could extend the project further mathematically by incorporating the idea of budgeting for production when making the chairs, and selling them
- You could extend the Language Arts connections by having the students create a media campaign to market their product
- By accessing an expert in a related field, students can see the real world connections, and this would increase the authenticity of the project

***Modifications/Accommodations***

- For ELL/ESL students, basic accommodations could include reduced workload, extra time, etc

- ELL/ESL students could create a video or podcast explaining their final product as opposed to a written infographic
- ELL/ESL students could create a visual infographic or flowchart to explain their work process, instead of writing
- Students could be asked to focus on specific tasks within the larger project
    - For example: one student could be tasked with creating the legs for the chair - managing only the measurement and reproduction of that one aspect
- When gathering information from the user, they could be asked to focus on one specific need (height, depth, etc), limiting the areas of focus for the students when designing and creating their chairs

***For Split Levelled Classes***

***To Include Grade 6***

- The students could be tasked with creating a chair that is designed to fit certain measurements within an airplane or spacecraft. This could also include an investigation into how the force of propulsion within those craft would affect the chair
- The project could touch on the Measurement strand of the Grade 6 Math curriculum, as well as addressing the Mathematical Process Expectations

***To Include Grade 8***

- You could have the students incorporate their knowledge of simple machines by creating a chair that involves movement
- You could have the students include movement via hydraulics or pneumatics (as in a dentist's chair, for example)
- The students could analyze the systems involved in the design and creation process
- The project could touch on the Measurement strand of the Grade 8 Math curriculum, as well as addressing the Mathematical Process Expectations

**WATCH THE VIDEO**
02:14 min

(//www.youtube.com/embed/I9m8Ho5RNHU?width=800&height=450&iframe=true)

## RESOURCES

- project outline cardboard chair challenge.docx (https://connex.stao.ca/sites/default/files/project_outline_-_cardboard_chair_challenge.docx)
- student outline.docx (https://connex.stao.ca/sites/default/files/student_outline.docx)
- independent journal entry outlines.docx (https://connex.stao.ca/sites/default/files/independent_journal_entry_outlines.docx)
- infographic examples.pdf (https://connex.stao.ca/sites/default/files/infographic_examples.pdf)
- student infographic examples.pdf (https://connex.stao.ca/sites/default/files/student_infographic_examples.pdf)
- activity 0 pre activity needs survey.docx (https://connex.stao.ca/sites/default/files/activity_0_-_pre-activity_-_needs_survey.docx)
- activity 1 independent research assignment.docx (https://connex.stao.ca/sites/default/files/activity_1_-_independent_research_assignment.docx)
- activity 2 great chair search.docx (https://connex.stao.ca/sites/default/files/activity_2_-_great_chair_search.docx)
- activity 3 concept sketches.docx (https://connex.stao.ca/sites/default/files/activity_3_-_concept_sketches.docx)

activity 4 user feedback.docx (https://connex.stao.ca/sites/default/files/activity_4_-_user_feedback.docx)

activity 5 independent poster2finfographic.docx (https://connex.stao.ca/sites/default/files/activity_5_-_independent_poster2finfographic.docx)

final chair assessment.docx (https://connex.stao.ca/sites/default/files/final_chair_assessment.docx)

independent journals assessment.docx (https://connex.stao.ca/sites/default/files/independent_journals_assessment.docx)

independent research rubric.docx (https://connex.stao.ca/sites/default/files/independent_research_rubric.docx)

posterinfographic assessment.docx (https://connex.stao.ca/sites/default/files/posterinfographic_assessment.docx)

## ELEMENT

Inquiry (/expert-elements/inquiry)

(/classroom-catalysts) RETURN TO CATALYSTS (/classroom-catalysts)