SPH4U: Cardboard Box Inventions

The “cardboard box invention” was a project first started by a nine-year old kid in Los Angeles



(http://imagination.is/our-projects/cardboard-challenge/). But why should the nine-year olds have all the fun? The challenge for you and your engineering group is to design a device or product that would be useful at home or in school that is mostly made from cardboard.

The Team

You may form an engineering team of up to three people. Groups of one are strongly discouraged and are only permissible under exceptional circumstances. You may work with students in other sections of grade 12 physics. Allocate the work wisely amongst the group members.

The Invention

Design and build a device that serves some useful purpose at home or school. The device must “do something”: it must have moving parts that help perform some interesting or useful task. The device can be a cardboard version of a commonly known device, or it can be an original device, never dreamed up before! Creativity and ingenuity are an important factor. The device must work. The primary material the device is made from should be cardboard. Additional materials are allowed, but there are cost limitations described below.

The Design Cycle

When engineers invent something, they create a solution to some practical problem using the engineering design cycle: define the problem, plan a solution, build the device, test the device, and repeat!

(1) Define the problem:

- Your invention is intended to solve a problem: study the problem you intend to solve.
- Develop clear guidelines for what a solution to the problem should accomplish.
- Create specifications that you will later use to test and measure whether your invention has successfully solved the problem.
- If you have already tested a version of your invention, you might realize that your problem or its specifications need to be changed. Record these changes in your design log.

(2) Plan a solution

- Create a simple, clear design drawing showing the design of your invention or modified invention based on your understanding of the problem and feedback from any tests you have already completed.
- Record, in a brief way, each group member’s contributions to the planning discussions in your design log

(3) Build the invention

- Construct the invention. The first version, the prototype, should be simple and quick to build. The prototype will help you learn about the construction process and the problem itself.
- For each subsequent version of the invention, construct them more and more carefully such that the final version is sturdy, reliable and easy to use.
- Photograph the invention to include in your log.

(4) Test the invention

- Test your invention in a realistic way. Photograph the testing process for your log.
- Measure how well your invention meets the criteria.
- Decide how well you think it succeeded in solving the problem. Identify any reasons why it was not successful.

Repeat (go back to step 1!)

The Design Log
The design log is the record of your group's design cycle processes. The details for every step of the design cycle should be recorded in your log, each time you go through the cycle. **Your group must go through the complete cycle three times.** If more than three cycles are necessary to produce a successful, working invention, only record and submit the log for the first two cycles and the very last cycle. If your invention works well the first time, identify useful improvements for the next round of the cycle or expand the definition of the problem so your invention has to work in a wider range of circumstances. The log is meant to be a brief summary of the steps in the design cycle: be concise.

The Cost Analysis
This is an appendix to your design log. You are encouraged to use recycled materials in a creative way as much as possible. Despite being recycled, the cost of the materials needs to be tallied and must not exceed $15 for your final product. Cardboard is special and is considered to be free, so the quantity of cardboard does not need to figure into your cost analysis. Any other parts and materials used in your invention need to be costed according to the prices listed on the websites for Home Depot or Staples. You do not need to purchase your materials from these stores; we just use the websites to help find costs. For each material included in your product (recycled or otherwise), find the closest item from one of the store websites to include in your analysis. If, for example, you use a paperclip, you would need to buy a pack of paperclips from Staples. The cost of the entire pack should be recorded in your analysis along with enough information to identify and order that item.

The Team Work Analysis
This is an appendix to your design log. Summarize the contributions of each group member to the overall project.

Submission
(a) **Initial Plan:** Submit the first two steps of the first design cycle (define the problem, plan a solution)
(b) **Complete Design Log:** Re-submit the marked copy of the Initial Plan (described above) along with the rest of the group's design log.
(c) **Final Product:** The final version of your invention will be submitted.

Invention Showcase
On the showcase day, you will demonstrate your final product in as realistic a way as possible. You will have your complete design log available at this time for visitors to examine. Both the invention and log will be submitted at the end of the showcase.

Important Dates
Initial Plan: Monday, November 30
Invention Showcase: Monday, December 14

SPH4U: Cardboard Box Inventions Evaluation

Group Members:_____

Final Product (30 marks)

The final version of your invention will be evaluated on how well it is built, the creativity of its design and how well it performs.

	Design (10 marks) ● Sturdy, survives repeated use, reliable, consistent operation, all materials have a useful purpose, all the parts help the invention complete its task, cardboard is an essential material, moving parts are essential for completing the task, you constructed all the important parts of the device, "Wow, that could be sold in a store!"
	Creativity (10 marks) ● Interesting or original purpose, does something useful, task is non-trivial, clever use of materials, ingenious design ideas, "Wow, I would never have thought cardboard could do that!"
	Performance (10 marks) ● Easy to use, smooth operation, successfully performs function, very little instruction/trial is required, "Wow, it works great!"

Design Log (30 marks)

The log has three purposes: (1) to convince the reader that your invention is well-designed and solves the problem; (2) to log the group's thoughts and efforts such that at any time, you could return to an earlier version of the invention and try different approaches; and (3) to prove that you and your group should get credit (marks!) for the development of this invention.

	Initial Plan (5 marks) ● Problem clearly stated, analyzed and specified ● Operation and construction of invention easy to understand from diagrams
	Clear (5 marks) ● Effective use of language, easy to find information/sections, clear visual organization and layout, encourages further reading, considerable time and care taken, does not need to be glossy/fancy
	Concise (5 marks) ● Each section is well-summarized: it contains enough information and illustrations to be convincing, clear and complete using a minimum of words ● Each section or illustration adds useful or unique information to the log ● Sections are not "padded" with similar or superfluous material to look lengthy or complete
	Complete (15 marks) ● Each round of the design cycle is carefully recorded in the log ● The Initial Plan is re-submitted as the first part of the log ● The cost analysis is carefully done such that anyone could quickly order the necessary parts ● The group work analysis presents a clear picture of who did what ● The log satisfies the three purposes stated above

Total Mark (60 marks): _____