



Traveling Water

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Overview:

Student teams will be creating water-powered vehicles given certain restrictions and guidelines as to vehicle weight, power source, and budget considerations. A competition to display the vehicles will be held about 5 weeks into the project.

Learning Objectives or Student Outcomes:

By the end of this lesson or activity, students will be able to

1. design a wheeled vehicle with a mass of at least 100.0 grams and a sole source of energy (to propel the vehicle) that is the potential energy of one pop can full of water that initially is 1.00 m above the ground.

Length of Project:

This project takes approximately 7 weeks. Factors which might alter the length of the project include: the amount of in-class time allotted to the project, the amount of out-of-class time deemed necessary by the instructor, and other activities which are scheduled to take place throughout the duration of the project.

Team Size:

Teams of 4 work best; if necessary, a few teams of 3 or 5 students may be formed.

How is *positive interdependence* ensured?

Teams will keep a team design journal, present team oral reports, and submit team written reports.

How is *individual accountability* ensured?

Individual accountability is ensured through peer assessments after project completion. Also, students will be given accountability through different parts of the report. In section 5, teams will be telling which team member will be responsible for doing what; in section 6, teams will include summary information on who was responsible for each aspect of the work and how long it took to complete tasks.

Components of Assessment:

Students will be provided a template with extensive guidelines for completing the written report, which comprises the majority of the grade. The report is turned in several times, each time in a state of further refinement; instructor feedback will be provided with each version. Students will also be keeping a team design journal—which will help them to organize their thoughts on the design process into the written report—and giving a team presentation about their project experience. The final product itself will also help comprise the project grade, although the competition will not.

Team Skills Needed for Success:

Team members must have the ability to cooperate, communicate and collaborate; they must also feel comfortable sharing their own ideas and giving and receiving constructive feedback.

Materials Needed by Students:

- a pop can
- water
- team-selected materials for the creation of the vehicle (purchased materials not to exceed \$15)
- team design journal

Multimedia Needs for Instructor:

If students plan to present using PowerPoint or another presentation software as their medium, be sure to have a presentation system available.

Instructions to Students:

1	<p>Project Description</p> <p>Basically, your team will be creating a water-powered vehicle given certain rules and restrictions as to vehicle weight, power source, and budget considerations. Throughout the project, you will be responsible for turning in more and more pieces of what will, in the end, amount to one final report. Each time you turn it in, it will be in a state of further refinement. In completing this report, you will use a given template. This will be described in more detail after the design rules and restrictions have been discussed.</p>
2	<p>Design Rules and Restrictions</p> <ul style="list-style-type: none"> • The wheeled vehicle must remain in contact with the ground at all times. • Energy transfer from the pop can full of water to the wheeled vehicle must occur over a period of time which is greater than 5.00 seconds. • The mechanism is ranked more highly if it travels farther from its starting point. • The mechanism is ranked more highly if it is judged to be more creative by the faculty team. • No team may spend more than \$15.00 on its mechanisms. If you have access to material on which you do not spend money, the cost on the material does not count against the \$15.00. A record of your project expenses, with supporting receipts, must be submitted in your final report.
3	<p>Assessment</p> <p>Assessment for this design project may be made via direct observation of your team, the team design journal, team written reports, team oral reports, and the final product itself.</p>
4	<p>Design Journals</p> <p>Your team will keep a design journal, documenting and detailing the steps involved in the creation of your design. This journal may be included in the</p>

	assessment. For your team, it will be a valuable tool in the creation of the written report.
5	<p>Written Reports</p> <p>Remember that in your report, you will be describing your progress in designing the system to people who have not participated in the deliberations of your team, that is, the instructors grading the project. Actually, you will be turning the same report in multiple times, and each time it will be in a state of further refinement. Please do not jump ahead of schedule; you need to wait for feedback on reports before continuing on.</p> <p>Because we want to clearly emphasize the steps that you will be making in the design process, the instructors have designed the format of your report and prepared a template document (Traveling Water Group Design Report) for you to work with. This document is a “skeleton” having the final format and organization that we desire with the details to be supplied by you, the designers. This template document also has detailed instructions on how it is to be completed.</p> <p>The final report will be written in increments, due at different checkpoints throughout the duration of the project. These are as follows:</p> <ul style="list-style-type: none"> • Submission #1 (1 week into project) Problem Definition Report Sections 1.0, 2.0, 3.0 • Submission #2 (2.5 weeks into project) Idea Generation Report Sections 1.0, 2.0, 3.0, 4.0 • Submission #3 (3 weeks into project) Decision Making Report Sections 1.0, 2.0, 3.0, 4.0, 5.0 • Submission #4 (7 weeks into project) Final Report Report Sections 1.0, 2.0, 3.0, 4.0, 5.0, 6.0
6	<p>The Competition</p> <p>The competition to display the vehicles will take place about 5 weeks into the project. Prizes will be given to the vehicles selected as most creative and the vehicles that travel the farthest. These prizes, however, will have NOTHING to do with the grade you are assigned for the project.</p>
7	<p>Oral Reports</p> <p>Teams will present oral reports at the conclusion of the project, giving the other students an overview of their project—what they designed, the process</p>

	they used, what they learned, etc. These may be used as part of the project assessment; more than anything, they will allow other students to learn from the successes, etc. of other groups.
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Handouts:

- [Traveling Water Group Design Report template](#)

NOTE: In the report template, there is mention of *competencies*, a *competency matrix* and *competency blocks*. This is based on a system used by The Rose-Hulman Institute of Technology Engineering Department where students assess themselves and are assessed by instructors on competencies met. Each of these references is highlighted.

Traveling Water Group Design Report

Group # _____
Name 1 _____
Name 2 _____
Name 3 _____
Name 4 _____

THIS TEMPLATE HAS BEEN DESIGNED TO LEAD YOU THROUGH THE REPORT PROCESS. PLEASE REMOVE THE ITEMS THAT ARE PLACED IN THE SAMPLE DOCUMENT FOR INSTRUCTION.

Executive Summary

The first section in the report should be an executive summary. The executive summary should contain two subsections. The first subsection is a summary of project results. The second subsection is a summary of what new competencies are being demonstrated in your final report. Details on the contents of the subsections follow.

Summary of Project Results

In the first subsection, the team should report the results of the project. The results summary should answer the following questions. How far did your vehicle travel? Did the vehicle meet the design specifications? Did you meet your goals for the project? Provide concrete examples to show whether or not your goals were met. Please make sure that the summary is well-written paragraph that addresses these questions. The first subsection should not be a list of questions with brief answers. It should be a well-constructed paragraph.

Summary of New Blocks Demonstrated

In the second subsection, the team should address what new competencies are being demonstrated in the final report. Each team member has received a report on what competencies have been demonstrated to date via oral and written reports. In the final report, the team should include a new copy of the page 12 competency matrix (not one of the existing copies). On the new page 12, the team should show what new competencies they believe they have demonstrated in the final report. The second subsection should provide a description of how the team believes they have demonstrated these new competencies. This input will be a valuable component in awarding new blocks based on the final written report.

1.0 Group Processing

Each time your team submits a project report you should process your team's performance and enter the results under the appropriate date. Please do not delete previous sections, but keep them so your team can see a record of previous entries, previous strengths and previous suggestions for improvement. Each group processing entry should include a short narrative describing the activities of your team, a list of present strengths of your team, and a list of suggestions for improvement. It is important to describe how your team has responded to the previous suggestions for improvement. Remember to include specific, concrete examples to support the statements about your team and its performance. If you list strengths, cite specific,

concrete examples of how your team has demonstrated of these strengths. If you list suggestions for improvement, list specific reasons why your team believes it is important to make these improvements. Remember that you are trying to demonstrate your understanding of effective team performance so that you may wish to also include descriptions of elements that encourage effective teams.

Keep adding to this section with each submission to record how your team functioned and improved. Please do not delete previous entries.

2.0 Defining the Situation

Here you are to define the situation as you see it. Think of this section of your report as an attempt to answer the following questions:

- Who?
- What?
- When?
- Where?
- Why?
- How?

This section should be more than a record of the obvious facts. Probe into the situation. Get at more than the facts on the surface. Focus on the importance of the situation, opportunities for outstanding performance, and challenges to be overcome. Be sure to have read about design processes and suggestions for implementing this step in the design process. This section will be graded based on how well you describe the problem you are faced with.

3.0 Stating the Goal

Your goal must be concise, but well thought-out and specific as well. **YOU MUST BE SPECIFIC AND CONCRETE.** You must say more than, “Our goal is to complete this design project.” You should pause to consider the necessary stages in arriving at a goal.

- Identify situation problems (Your statement of the goal should depend on your definition of the situation in the previous section)
- Create goal options (Consider several alternative goal statements)
- Select the goal from these options (State why your team believes your selected statement is the more appropriate goal statement.)

This section must take less than a page. **“Just going through the motions” will earn few competency blocks.** What happens if your goal changes? Feel free to amend this section when you turn it in with a later update.

4.0 Generating Ideas

Let the creativity begin! You are to brainstorm ways of designing an engineering system that will meet the specifications of your goal. We would not be surprised if each group could come up with literally dozens of ideas for this project. What you are to do in this section of the report is to generate as many ideas as you can that would work—in other words: that would accomplish your goal.

Think of the idea generating process as having three parts:

- Identify goal problems. This step involves analysis.
- Create Idea Options. This step is synthesis.
- Select Ideas. This is the evaluation step.

Go through these steps and work with as many ideas as you feel comfortable with. We are expecting at least three ideas to be in consideration when this section of the report is finished. In this preliminary part of section 3, you must try to identify as many of the problems associated with reaching your goal as possible. When this list of problems is completed, delete the instructions in this part of the template and substitute your list. Use bullets. Here is an example.

- Energy transfer -- etc.

4.1 Idea Number 1

Your individual ideas should be discussed under subheadings such as the one just above. Describe the idea briefly. How does it solve the goal problems? Is this idea to be considered a possible option, or is it to be rejected from further consideration.

4.2 Idea Number 2

Et cetera. Every time you want to describe a new idea, start a new paragraph. If you are using the Frame template, use the paragraph style "Heading 2."

Remember, you can put as many ideas as you want in here, no matter how wild. At least three ideas must be submitted.

5.0 Preparing a Plan

O.K. You're making progress! It is now time to prepare a plan of action using the ideas generated so far. A new situation is before you; plans are on the table. You are now to critique the ideas being considered. What weaknesses and problems do you see in each? What options do you have now? Are there ways of synthesizing a plan out of the ideas generated? Finally, after considering the goal, selected ideas, constraints, and potential problems, and identify the best plan. Describe your plan in this section. Include

5.1 A physical description of your intended design

You are also allowed to submit drawings made with any computer program that you have access to. Finally, neat hand made drawings will also be accepted.

5.2 A step-by-step account of how it is to be executed.

Who will be doing what and when?

5.3 Cost estimates to the best of your ability

What you think it will cost.

5.4 Performance estimates to the best of your ability

What you think it will be able to do.

As with the previous sections, this section will probably be updated more than once. You may try something that just doesn't work well. No problem. Update this section and the previous one as well, then select a new plan.

6.0 Implementation

What problems are associated with the chosen plan? Analyze you chosen plan carefully. Next imagine options in carrying it out, or variations on the main theme. Try to anticipate problems

that will occur. Carry out your plan, and describe what happens. This section of your report will have sub-parts as follows.

6.1 Chronology

State in this section of your report who was responsible for each aspect of the work, and how long it took you to actually build your system.

6.2 Cost

This section is where you record the actual costs of materials for your system. You must save all receipts.

6.3 Performance Tests

You must try out your device. Describe the tests that you used and their results.

6.4 Final Evaluation

What is your opinion of the results of your project so far? Be as objective as possible. Do you need to go back and refine your ideas and make another iteration? Should you go to a different plan? Should you even pick a different goal?

7.0 Instructor's Comments and Grade so far

This section will be appended to your report for your instructor to use to communicate his/her overall impressions of your work so far. *Nothing to do here.*