PREFACE

The purpose of this "paper" is to introduce Straw Bridge Challenge participants to an example of a technical academic paper format. The format of this paper can be applied to almost any science or lab project you might be asked write up from middle school all the way through college. Historically this format was developed in the days of mechanical typewriters when there was only one font and limited formatting options. With today's word processors type fonts and formatting options can be seemingly infinite. This becomes a problem as students can become distracted with features of the word processor and forget the main point of the paper is to communicate to the reader information about the study and what was learned during the course of the project.

The classic academic paper is written on 8-1/2" X 11" paper, double line spacing with a 10 to 12 point Times New Roman, Courier or a very similar font. Margins should be 1 inch on all sides. Part of the presentation score for papers will be based on how closely this basic format is followed. Please note that double line spacing is important as it provides space for editing, comments and corrections by the teacher or other evaluators.

A technical academic paper will typically include five main sections: Introduction, Research and Literature Review, Experimental Investigations, Results and Conclusions. In this example paper it will be pointed out the types of things that students should consider placing and discussing in each section.

The last page is an example bibliography that also gives some ideas for bound reference materials pertinent to bridge design. This gives a general example of how printed materials should be listed in a bibliography. For more information on this topic a writer can consult books or electronic reference under the topic of Term Paper Guides or Paper Writing Style Guides.

This example will start with a title page in a proper format and then present each section as it should appear in a proper academic paper. For short papers the table of contents can be eliminated. This entire paper is written in Times New Roman 12 point font, without bolding, italics or underlines. It is written as if all that was available was a classic typewriter; the paper is clear and readable.

Students should not feel that they cannot use any of the features, such as bold typeface or increased font size for section titles, however papers that utilize multiple typefaces, excessive amounts of clipart, excessively large typefaces or oddball line spacing can become difficult to read and will often receive a poorer evaluation simply because the reader had difficulty absorbing the content of the paper.

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THE FANTASTIC MIDDLE SCHOOL

STUDY IN THE DEVELOPMENT OF DRINKING STRAW BRIDGES

A PAPER SUBMITTED TO THE
STRAW BRIDGE CHALLENGE JUDGES
AS DIRECTED IN THE RULES FOR THE
STRAW BRIDGE CHALLENGE

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INTRODUCTION

As the name implies, this is where you will introduce the project. Write this section as though someone who has never heard about the Straw Bridge Challenge is going to learn about it by reading your paper. You can start by introducing the team and briefing the important parts of the rules, specifically the objective and materials to be used. You may also consider discussing your approach to the challenge, is your team a group of interested students working independently outside of your school? Is your team part of a science club meeting during lunch or after school? Or, is your team formed inside of a formal science or technology class and this bridge project is being included as part of your curriculum? These are all items that a reader should be able to learn or will be interested in that should be considered the first few lines of your paper.

The later parts of the introduction should include a discussion about your approach to the project. How did you divide up the work? How did you decide to divide up the work? Where and how often did you meet to work on your bridge project? Did you make any special trips to look at bridges in your local area or to gain access to any special resources?

By the end of the introduction the reader should have a good idea of what they are going to read about, why you are building a model bridge from drinking straws, what some of the details regarding the structure of your team and how you approached the project are going to be.

LITERATURE REVIEW AND OTHER RESEARCH

When you start any research project one of the first thing a good researcher does is try to learn what colleagues in the same line of research have already figured out. By learning what others have already done you can improve your own experiments and research and also help to

advance science and engineering beyond what has already been developed or discovered. In short, it is not a good use of time to rediscover what someone has already figured out and written down.

In the case of the Straw Bridge Challenge you will likely be doing your research to learn about bridges for the first time. In the case of a topic like bridges where, clearly they are well developed and in common use you may consider discussing the history and significance of bridges, the numerous types of bridges and where or why certain types of bridges are used in particular situations and what the advantages or disadvantages of some bridge types may be.

As the title of this section implies, this is mostly the reading part of the project. It is the challenger's responsibility to look for books, magazine articles, short videos, web pages and even educational software pertaining to bridges or, after you have done some selection of the type of bridge you are going to use, specific articles on your particular bridge type or articles about specific design elements of your bridge type. This is where you should try to get a good mix of sources. Although the internet can be a valuable source of information, do not overlook other resources that may exist in your library or your local community. Keep track of the books and articles you read, at the end of a paper the authors are expected to include a bibliography that lists all of the information sources used in researching and preparing the paper, failure to give credit to others for their foundation work is a serious omission. The more diverse the sources of information the better balanced your literature review will be and also the more likely you will be able to develop sound experiments that will help you rapidly refine your bridge design. While too little background research can hurt your project be careful not to spend too much time on this section either as the development of experiments to help you design your bridge will be very important as well.

EXPERIMENTS

For a major scientific paper this section could also be called “Design of Experiment” but for the case of the Straw Bridge Challenge you will most likely perform several smaller experiments not one large complex experiment. After a period of reading and looking at bridges, a team should set up some experiments of their own. There really aren’t any articles written about building bridges from drinking straws so a thoughtful team will need to study the straw for properties similar to those that make steel and concrete the material of choice for so many real bridges. Steel and concrete have listed strengths for compressive and tensile loads, formed into specific shapes concrete, steel and other materials will exhibit specific properties in bending. Early in your bridge design project the properties of tension, compression and bending will be of the most interest. Very quickly you will become more interested in how pieces of drinking straw can be joined into simple structures that will eventually make up the larger structure of your entire bridge. As you progress through each stage you might design some experiments to test some of your design ideas. The experiments section is where these tests will be presented and explained.

A test might be introduced very simply by stating the concern and the method that was developed to test that concern. For instance, “To test the change in strength of the straw in loud environments a procedure was developed where some weight was put on a straw and a radio with the volume turned up was placed next to the test fixture.” The next few lines might describe how the weight was placed on the straw and how close the radio was to the test fixture.

After you have introduced your experiments you will want to present the results of those experiments, presentation will come in the next section. It is expected that you will likely

perform numerous small experiments, do not try to cover every test you might have performed in the experiments section, only ones that gave your team significant insight into how to improve or tailor your bridge design to best meet the requirements of the competition.

RESULTS, DISCUSSION AND DESIGN

After doing research and literature review and performing a number of tests and experiments, this is the section where you will present what has been learned and how it has guided the type selection and development of your bridge. Specific points from the literature review can be mentioned, with footnotes if appropriate. For simple tests a brief statement of the results is sufficient for more involved tests a table or chart can be helpful. Consider the example below for the speed and distance of an object dropped off from a building.

Time (seconds)	Velocity (meters/second)	Distance (meters)
0.00	0.00	0.00
1.00	9.81	4.91
2.00	19.62	19.62
3.00	29.43	44.15
4.00	39.24	78.48
5.00	49.05	122.63
6.00	58.86	176.58
7.00	68.67	240.35
8.00	78.48	313.92
9.00	88.29	397.31
10.00	98.10	490.50

Table 1, predicted velocity and distance for a heavy object dropped from a tall building.

While tables can be a handy way of presenting data, sometimes a chart or graph can present something visually that will not be immediately obvious by just looking at a table of

numbers. Figure 1 provides an example of what the Distance vs. Time data presented in Table 1 might look like.

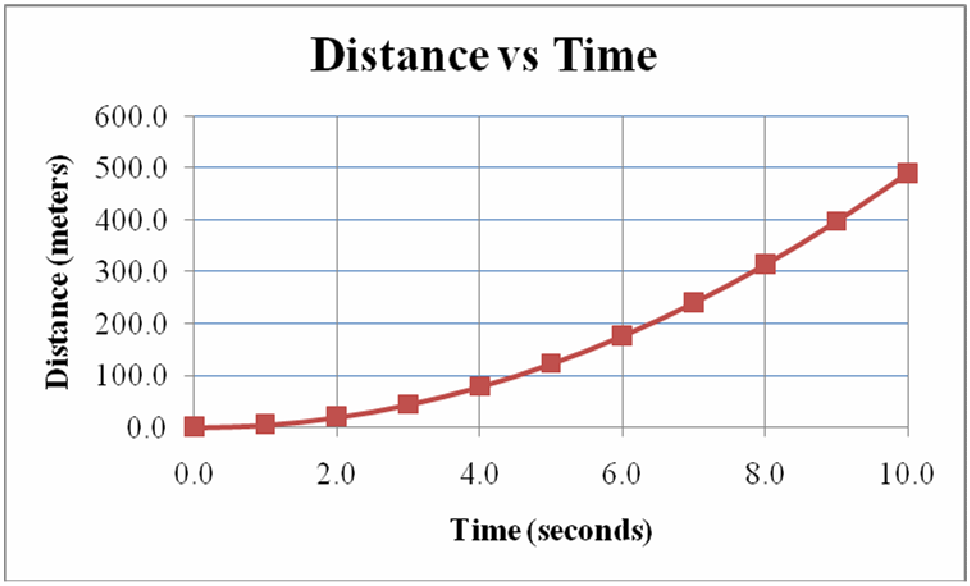

Figure 1, Graph showing relationship between distance and time for a heavy object dropped from a tall building.

In this section you not only present your results and new knowledge but most importantly present a case for why a certain type of bridge is best suited for this challenge and what some of the key points about drinking straws are that might make give one design an advantage over another. Points that you might want to touch on would be: strength attributes of a drinking straw, drinking straw joints, shapes or substructures that might provide the greatest strength and how this might indicate a certain type of bridge might have a competitive advantage over another type of bridge.

After completing background research and testing and deciding on a type of bridge, for a development project such as Straw Bridge Challenge this would be the section where you would introduce your design. You would likely state, you are designing a bridge of a specific type and then detail out your design. DO NOT forget to include drawing or sketches of what your

planned bridge should look like. Drawings of what you intend to build are helpful, not only when building the bridge, but also when telling the story about building the bridge. There are no specific correct answers for this section, this is the chance for the team to develop and support your case for why you have chosen to build the type of bridge that you have and why you have made your bridge look the way it does.

CONCLUSIONS

The team has spent a significant amount of time learning about bridges and deciding what type or style of bridge to build and even making a few sample sketches and drawings, this is where you discuss the building of your bridge and present it.

The conclusion section is usually a concise wrap up of points brought out in Results, Discussion and Design. A picture of your completed bridge in this section is usually helpful. You can discuss difficulties in getting your bridge constructed and perhaps some final testing and tweaking to optimize your bridge. How many bridges did you build before you built your competition bridge? What are the key points that make your bridge successful and what would you do differently if you were going to start from scratch and do the entire challenge again. Similar to the last section, there are no specific correct answers, only your teams ideas on what you would do to make a better bridge if you were going to do the entire challenge a second time.

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