Cardboard Boats

Objective:

- To build a boat out of cardboard and tape capable of holding two people that can be launched and paddled for one lap of a pool.
- To research and apply Archimedes' Principle, density, displacement, surface area volume, scale models in the creation of your boat.

You will work in student teams of up to four students. This will be a multi-week assignment. Boats are due Tuesday April 24th.

Materials:

1. Only cardboard and tape may be used to construct the boat.
2. Only corrugated cardboard will be allowed.
3. You may NOT use any other objects to contribute to the structural rigidity or the craft's flotation ability. If you have any doubts about what might or might not be legal, ask your teacher.
4. Clear, cheap tape is best. The very best is clear, cheap packing or postal tape that is about 2 inches wide. NO GLUE!

Design Parameters: Boats will be subject to a technical inspection and must follow these guidelines:

1. Boats must be made from corrugated cardboard. The entire hull, superstructure, and seating must also be made from corrugated cardboard. The maximum thickness of cardboard allowed is two sheets thick.
2. The maximum length is 8 feet. The dimensions of the boat must be such to permit it to enter the doors to the pool area.
3. The hull may not be wrapped in plastic, duct tape, shrink-wrap, or anything else. Only the seams and joints may be taped, not the entire boat. In other words, you may only tape where you put two pieces of cardboard together.
4. Swimming on a cardboard surfboard is not allowed.
5. The passengers of your boat may not be enclosed above the shoulders of the occupants. Both people must be visible while the boat is in the water.
6. Boats must be free of sharp edges, objects with pointed edges, or any other menace.
7. All occupants of a boat must be good swimmers. A lifeguard will be present.
8. All boats may be propelled through the water by constructing a device(s) made of cardboard.
9. No arms or legs may be in the water to assist with stability or propulsion.
10. To qualify as a finisher, both teammates must be in the boat at the end of the race.

Grading Guidelines:
Log – worth 50 points

Each group member must keep an individual personal log of progress. Record work done individually or as a group in the accomplishment of your boat project. Keep a detailed record of date, time, members present and a through list of steps including what was accomplished at each session. The log is to be turned in on the day of the race.

Group Grade for Boat – worth 100 points

- Any boat that makes it off the starting line will earn 80 points.
- Any boat that successfully negotiates one-quarter of a lap will receive 85 points.
- Any boat that successfully negotiates one-half of a lap (a length) will receive 90 points.
- Any boat that successfully negotiates three-quarters of a lap will receive 95 points.
- Any boat that successfully negotiates an entire lap will receive 100 points.

Group Evaluation – worth 20 points due Friday April 27th

Each group member will receive an evaluation form to evaluate your groups' ability to work together in the construction of your boat.

Individual Summary of Project (typed)– worth 100 points due Monday April 30th

1. 2-3 paragraph description of how you would change your design. In other words, what part of your design was effective? What part of your design did not work? How would you change it? *25 points*

2. Describe three things that you saw other students do that you consider being very effective. *25 points*

3. Archimedes Principle states that "The buoyant force on a body immersed in a fluid is equal to the weight of the fluid displaced by that object." An object floats when its weight is equal to the buoyant force. Write a one-paragraph description of how this principle applies to the floatation of your boat. (Diagrams and sketches could be very helpful) *25 points*

4. Describe calculations involved in making your boat. How did you determine how much water needs to be replaced? How would you calculate the buoyant force exerted on your boat by the water? What measurement would you take and how would you interpret them? (It is also expected that a good deal of this information is in your personal log) *25 points*

Boat Design – To ensure groups follow the aforementioned design parameters, the following rubric will be used in grading boat design.

Design Parameters Rubric	Points Possible	Points Received
Boats must be made from corrugated cardboard. The entire hull, superstructure, and seating must also be made from corrugated cardboard. The maximum thickness of cardboard allowed is two sheets thick	5	
Maximum length is 8 feet. The dimensions of the boat are such to permit it to enter the doors to the pool area	5	
The hull may **not** be wrapped in plastic, duct tape, shrink wrap, or anything else. Only the seams and joints may be taped, not the entire boat. In other words, you may only tape where two pieces or cardboard are put together.	5	
Passengers of boat may not be enclosed above the shoulders of the occupants. Both people must be visible while the boat is in the water.	5	
Boats must be free of sharp edges, objects with pointed edges, or any other menace.	5	
Boats may be propelled through the water by • the paddles provided • constructing a device that will power the vessel, such as a paddle wheel • a sail • or any combination of the above	5	
TOTAL	30	

Assignment	Points Possible	Points Received
Log	50	
Group Grade for Boat	100	
Group Evaluation	20	
Summary	100	
Design Parameters Rubric	30	
TOTAL - - - - - - - - >	300	

Group Evaluation

Your Name _____

Group Members: _____

On a scale of 1 to 10, rate how your group worked together (10 being high functioning): _____

Do you feel all members of your group were able to contribute a fairly equal amount to the groups' project? Explain your answer.

What we some obstacles your group faced in working together?

Do you think your group had an understanding of the concepts necessary to build a boat? Explain.

What were some things you liked about this project?

What would be your suggestions for your teacher or future physics students if we are to do this project again in the future?