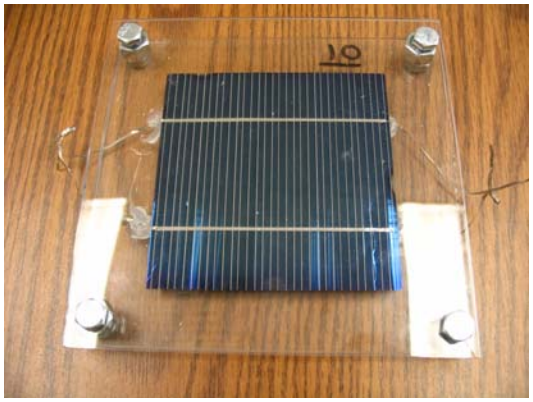
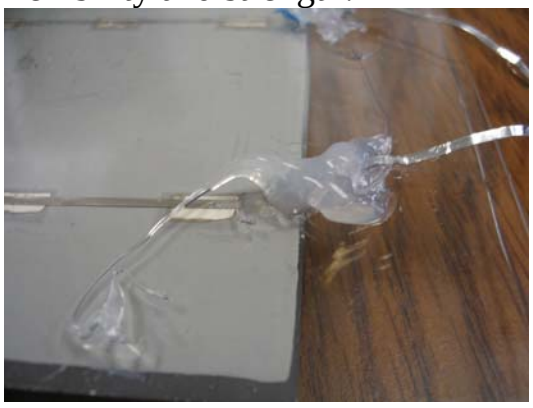
Summary Comments

Background Information

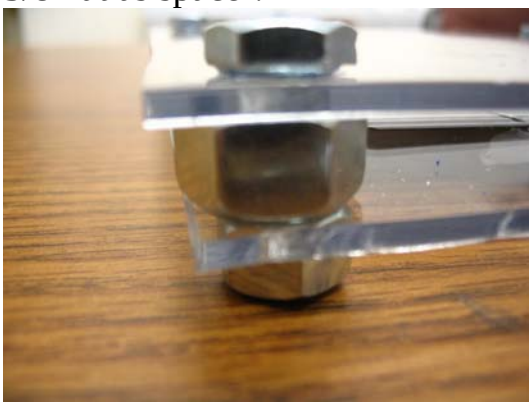
The solar cells were well protected by the plexiglass sandwich modules that we built for them. The cells (ASE Americas) were 4" square with leads soldered on for external connection:



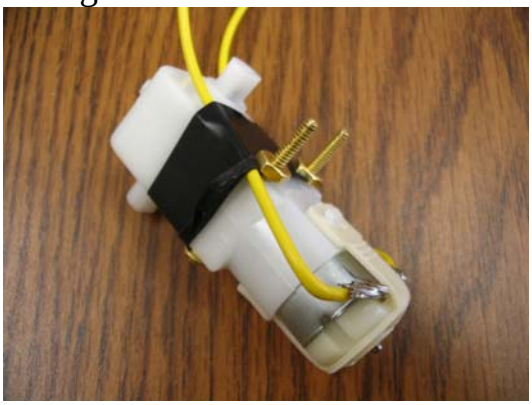
The leads were fed through small holes in the back of one sheet of the plexiglass and fixed in place with RTV silicone rubber bathtub sealer. This kept the wires in place and allowed for a good balance of flexibility and strength:



Finally, to protect the cells further, a reasonable air-gap was left between front and back plexiglass sheets to allow for minor bending and stresses – without having those forces exerted on the cells themselves. Here is a pic of the spacer used at each corner of the cell (3/4" long 1/4-20 bolts with 3/8 nut as spacer:



The motors were purchased from HobbyEngineering.com and came with gear-down assemblies:



Each team was provided with one of these motors and standardized wheels were provided that could be easily attached to the shaft – but no restriction was placed on what radius *should* be used for adjusting the torques. One problem with the motors was that the electrical contacts were relatively weak so that the wires that we soldered on were best tied down with black electrical tape to keep the contacts from flexing too much.

Team Designs and Results

All teams selected series connection of the solar cells. And, the specific illumination conditions for the cells by the lamps (indoors) were not very important. The solar cells were substantially too high powered in comparison to the characteristics of the motors that we had. The series connection gave the highest voltage and then allowed for the best motor performance:



The competition results are summarized in the following table:

Team Number	Time	Mass (g)	Height (ft)
1	4:06	464.6	5.00
2	1:52	222.2	5.00
3	3:31	523.2	5.00
4	4:11	305.9	4.25
5	4:33	691.8	5.00
6	3:45	465.1	4.00
7	2:05	302.0	5.00

These data were analyzed to determine the total work done by each team:

Team	Mass (kg)	Height (m)	Work (J)
5	0.6918	1.524	10.332
3	0.5232	1.524	7.814
1	0.4646	1.524	6.939
6	0.4651	1.2192	5.557
7	0.3020	1.524	4.510
4	0.3059	1.2954	3.883
2	0.2222	1.524	3.319

Analysis

Team 5 had the smallest diameter wheel of all teams:

Team	Radius	Power	Work
5	0.008	0.038	10.332
3	0.015	0.037	7.814
1	0.016	0.028	6.939
6	0.015	0.025	5.557
7	0.033	0.036	4.510
4	0.015	0.015	3.883
2	0.035	0.030	3.319

This meant that they were able to operate closer to the peak power point for the motor and get the best power out. They were also able to design their weight and rotation rate to use that peak power for nearly the full 5 minute period and therefore do the most work.

Interestingly there were two other teams who generated almost the same power, but didn't optimize the time well enough (teams 3 and 7). Team 7 reached the top in about 2 minutes and team 3 reached the top in about 3 ½ minutes. Here are the power generation rates for each team:

Team	Mass (kg)	Height (m)	Power (Watts)
5	0.6918	1.524	0.038
3	0.5232	1.524	0.037
7	0.3020	1.524	0.036
2	0.2222	1.524	0.030
1	0.4646	1.524	0.028
6	0.4651	1.2192	0.025
4	0.3059	1.2954	0.015

Finally, it is important to serve refreshments during the competition:

