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2.007 Design and Manufacturing I  
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## **Kit and Contest Exploration**

**Schedule for: week of 2 - 6 February**

**Deliverable: 4-6 pages in your lab notebook**

### **Week's Activities**

The first objective of this week's activities is for you to become knowledgeable about your kit and the contest so that you can design with (a) competence and (b) confidence. The second objective is to prepare for building your simple car next week.

You will not have a lab during the first week of classes, but you will be able to get your kit and work in the Pappalardo Lab. Come to your first scheduled lab in the second week with your lab notebook prepared to review your deliverables from this week with your lab instructor.

### **1. Kit Exploration**

Your kit contains mechanical materials like metal stock, wood stock, gears, and springs and actuators and servos. Explore the properties of these and explore how they might be used/applied to your potential design.

Concerning the materials first, ask yourself how these materials can be used to build the platform(s) (car) you will need to maneuver around the table and support your functional modules. You will need to implement some kind of grabbers, can crushers, lifting and positioning devices, release mechanisms, etc. So think about what each element could be used for and how it might be cut, shaped, formed, and attached to other components. Think about required strengths of materials as you do this.

As for the actuators, the energy and power supplied by these are critical to the design at hand. During this week, you should first access and assemble all relevant specifications to build a data base. Then explore, for instance, how the torque and rotary velocity from the servos can be converted into force and linear velocity. Think about the amount of energy provided by other active devices and then explore what it can be used for. (You will find that available energy and power heavily constrain what you might select to do!)

### **2. Contest Exploration**

It is clear that the contest rules and design allow for, indeed encourage, a variety of approaches to competing. Most importantly you have a variety of ways to score, and may want to consider defending yourself against opponents. Some examples of areas you might explore: 1. What role does friction of wheels against the table play? 2. What are typical times to move about the table? 3. If you get engaged in a tug of war over the plant, what limits the maximum force you can apply? 4. What are feasible ways to crunch cans so that they can be placed into the storage slot? etc. Try to develop specific concepts that will help lead to a robust strategy.

### **3. Platform (Car) Design**

One of next week's activities is to build a simple car (platform), which you will then test and refine the following week. By the end of week 3 you should be able to

drive around the table and simulate your strategy in real-time. It is useful to consider the car as a platform for your functional modules. You are supplied a standard design, but you are encouraged to modify this as appropriate to your emergent strategy. For instance, you may have a strategy that requires a more stable and therefore bigger base, or you may opt for maneuverability with a smaller car.

## **Milestone 1 Specific Deliverables**

Every week, the deliverables should be documented in your laboratory notebook. Your lab instructor will tell you how to handle your notebooks. Most lab instructors have you turn in your notebooks to a collection box sometime before the following week's laboratory so she/he can review them before the lab.

The purpose of keeping laboratory notebooks is to introduce you to standard industrial design practices, where the keeping of laboratory notebooks is mandatory. What goes in the notebook should not be a history of everything you have done, but rather a concise summary of experiments, analyses, designs, etc you have carried out. Emphasize not the activity itself, but the output and conclusions of the activity. For instance, if your contest strategy called for high-speed maneuverability, analyses of what terminal velocity you could obtain with a presumed design would be a very appropriate analysis.

### **1. Kit Exploration Deliverable**

Summarize what initial directions and conclusions you have reached from your kit exploration. (It's always helpful to look at previous year's machines for ideas!)

### **2. Strategy Deliverable**

To stretch your thinking, develop and summarize three (quite different!) overviews of strategies you might use in the competition, eg a super can crusher, a speedy multi-function design. Explore scoring possibilities associated with each strategy. Think about how you will evolve to your final strategy and how you will demonstrate feasibility. A sketch of the strategy on the contest table would be useful.

### **3. Car Deliverable**

If you revise the car design, do a drawing of your car design, labeled as to appropriate details and materials. (Remember that to use the Pappalardo Laboratory machines you must have a design in hand before you do manufacturing work in the shop. The laboratory people enforce this rule.) Document any changes to the design and why you made them. Project the initial acceleration of your car and what its steady state velocity could be.

N.B. In 2.007, you will not be told exactly what to do with your lab time, i.e., solve this specific problem. Instead these milestone notes provide suggestions for appropriate activities, analyses, and experiments. It is for you to determine exactly what to do based on your strategy, your plan, your specific design, etc. And the deliverables are worded in general form as well so you can devote your time in and out of lab to what is most appropriate for your design and schedule.