SolidWorks and Vacuum Forming and Part Finishing Oh my!
designy
QR Codes

Scan QR codes with a phone

Visit "recently viewed" on a laptop
Decide on **one** toy concept

2 models

Looks like

Works like

Refined designing and building techniques
Before Lab...

Review the feedback! Especially the product you didn't work on.

Note down interesting points in your lab notebooks. Notebook checks will be this week.
Mockup: Works-like

Addressing critical questions for the final product, mechanisms, assembly, remaining questions on play

Closer in play to the final product (less *Wizard of Oz!*)

Reasonable planning and less focus on the appearance
Mockup: Looks-like

Closer in appearance to the final product

Addressing critical questions

Visual, sizing (kids and implementation), texture, etc.

Technique questions
Workshop: Electronics II

This **Sunday 2:30-4:30, room 3-442**

Soldering, wireless communication, and more!

Signup on the course website
Today!

Solidworks (3-370)

Vacuum Forming & Part Finishing (PDL)
Estimation Game

How many Prus across the Harvard Bridge?

Pru height?

~230m

Harvard bridge length?

~620m

between 2 and 3

50m
Estimation Game

Cost per kernel of popcorn at the theatre?

price of bucket?

volume of bucket?

volume of popped corn kernel (packing factor)?

~0.25–1¢ per kernel
Estimation Game

Energy to brush?

How fast is your arm moving while brushing?

\[ E_k = 0.5mv^2 \]

How often do you change direction? How long should you brush?

0.5s, 120s

\(~120 J\)
Estimation Game

Mechanical Bull in House?

power requirement for mechanical bull?

standard voltage in house?

standard circuit breaker current?

240V x 30A = 7200W
120V x 15A = 1800W

~ sure
Estimation Game

Hot dog in the Easy Bake?

Q = mC_pΔT

50–200g and 20–60°C

Power of Easy Bake

5-10 min without losses
Quiz!

What is your name?

What is energy? Units?

What is power? Units?

What are the top three sources of electricity in the USA?
Energy

a measure of the potential for change

never created or destroyed

converted between different forms!

Joules!

\[ J = N \cdot m = \text{kg \, m}^2/\text{s}^2 \]
Energy Range

10 kg, 1 m

sunflower seed

AA Cell

D Cell

1.5 ton car

SPEED LIMIT 70

1 Gallon

100 J  1kJ  10 kJ  100 kJ  1 MJ  10 MJ  100 MJ

kJ = Thousand J
MJ = Million J
Power

Rate

Amount of work or energy transfer per unit time

Units of Watts or J/s

1 horsepower = 746 W

nascar engine

x 850

= 634 kW
Power Range

- 1 W
- 100 W
- 1 kW
- 10 kW
- 100 kW
- 1 MW
- 10 MW

kW = Thousand W
MW = Million W

MIT Building 39

Toys!
Basics of CAD
When to use CAD?

- detailed planning
- calculating
- digital fabrication

- quick prototypes
- organic shapes
SolidWorks Navigation

- **Feature Tree**
- **Command Bar**
- **Model Window**
Simple Box

Select the “Front” plane
Create a new sketch
Create a “Center Rectangle” from the origin
Smart Dimension the length and width in inches
Change the View

Change the view to “Trimetric”

Use middle-click and drag to free rotate
Extrude

Extrude the sketch

Choose “Mid Plane”, and set to 3.125"
Modifying the Sketch

Delete the extruded feature (we’ll come back to that later)

Edit the sketch, draw a horizontal line below the box

Set the line as “for construction”

Dimension the line 0.275" below the box
Sketching the Wheel

Draw a circle, connecting the edge to the construction line so it is tangent.
Dimension the circle 1" away from the front.
Dimension the diameter as 42mm (notice it change to inches).
**New Sketch**

Create a new sketch on the “Front” plane

Use “Convert Entities”

Select the rectangle to convert (this brings it to the new sketch)

Extrude the box as before, with “Mid Plane” & 3.125"
Reference Plane

In the top menu, choose: “Insert > Reference Geometry > Plane”
Set the plane 0.10" away from the box face
New Sketch

Create a new sketch on the new reference plane
Use “Convert Entities” again
Select the circle to bring it onto this new sketch
Extrude the wheel

Set the extrude as “Blind” and to 0.60"

Uncheck the box for “Merge result”  

really, do it!
Round the Corners

Select the “Fillet” tool
Select the edges of the box to fillet
Set the radius to 0.25"
Round the Edges of the Wheels

Select the “Fillet” tool
Select the edges of the wheel to fillet
Set the radius to 0.125"
**Mirror the Wheels**

Select the “Mirror” tool

Choose to mirror about the “Front” plane

Go to “Bodies to Mirror”, then click on the wheel in the model window (you can check preview to see what will happen)
Mirror the Wheels

Select the “Mirror” tool again

Choose to mirror about the “Right” plane

Go to “Bodies to Mirror”, then click on the two wheels in the model window
Sketch the Canopy

Edit the original sketch on the “Front” plane

Sketch a line at an angle on the left side

Draw an arc tangent to the angled line and ending on the right, at the top of the car

Dimension from the edges: 1.70", 2.00", and angle of 25°

(Also, try dragging around the point on the left to change the shape of the canopy)
Extrude the Canopy

Create a new sketch on the “Front” plane
Use “Convert Entities” to bring over the canopy sketch
Draw a line to close the canopy shape
Extrude the canopy using “Mid Plane” and set to 2.25"
Uncheck the box for “Merge result”
Round the Edges of the Canopy

Make sure you unchecked the box for “Merge result” from the previous step

Fillet the top edges of the canopy to 0.35"
Hide the Body

Right click on the feature for the car body, and choose “Hide” to make it invisible

Rotate the view to see the underside of the canopy

Right click to “Hide”
Shell the Canopy

Select the “Shell” tool

Set the shell thickness to 0.10"

(notice how this hollows out the canopy)
Glass Canopy

Flip the car back around using “Isometric”
Make the car body visible again by right-clicking “Edit the Appearance” to make it more realistic
Other things to try...

Try modifying the original rectangle for the car body to make it better match the Automoblox cars

What happens when you change the dimension for the “ground clearance” construction line?

Try adding a spoiler or other detail

Make axles and corresponding holes for the wheels
Create new parts from existing bodies

Expand the “Solid Bodies” folder
Right click on the “canopy” body
Choose “Insert into New Part…”
SolidWorks and Vacuum Forming and Part Finishing Oh my!

Take blade boxes!