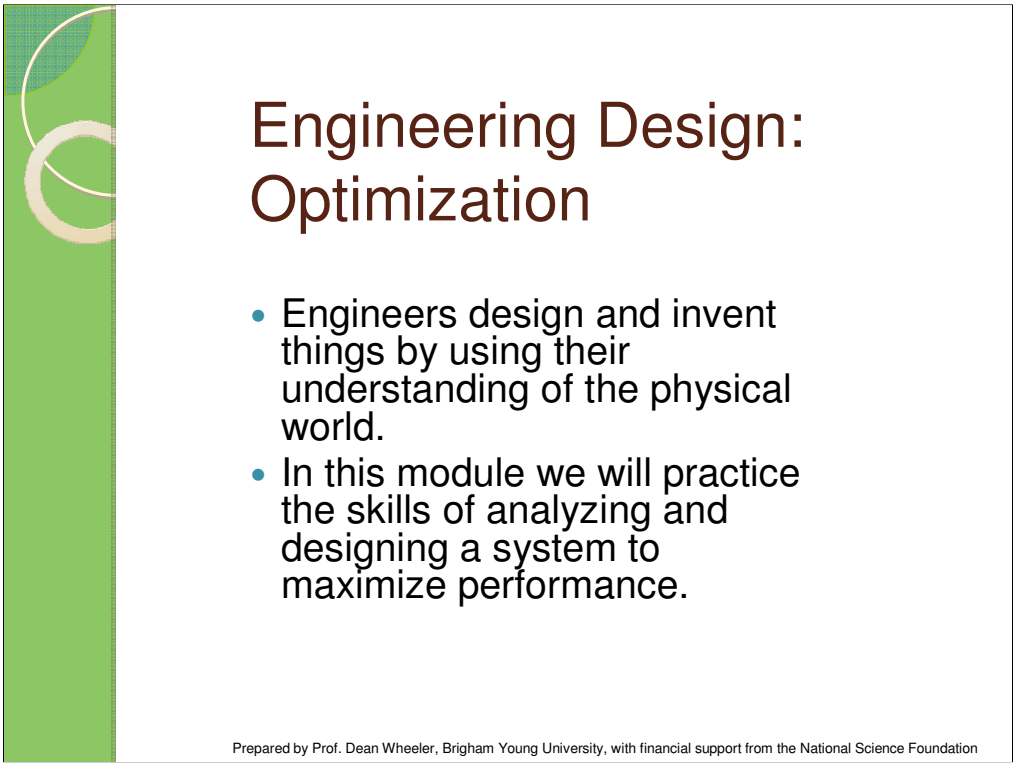
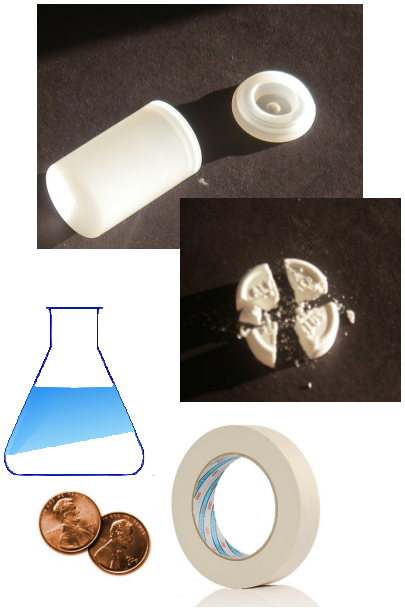


See http://www.et.byu.edu/~wheeler/demos ; requires accompanying video file

Alka-Seltzer rocket

Supplies:

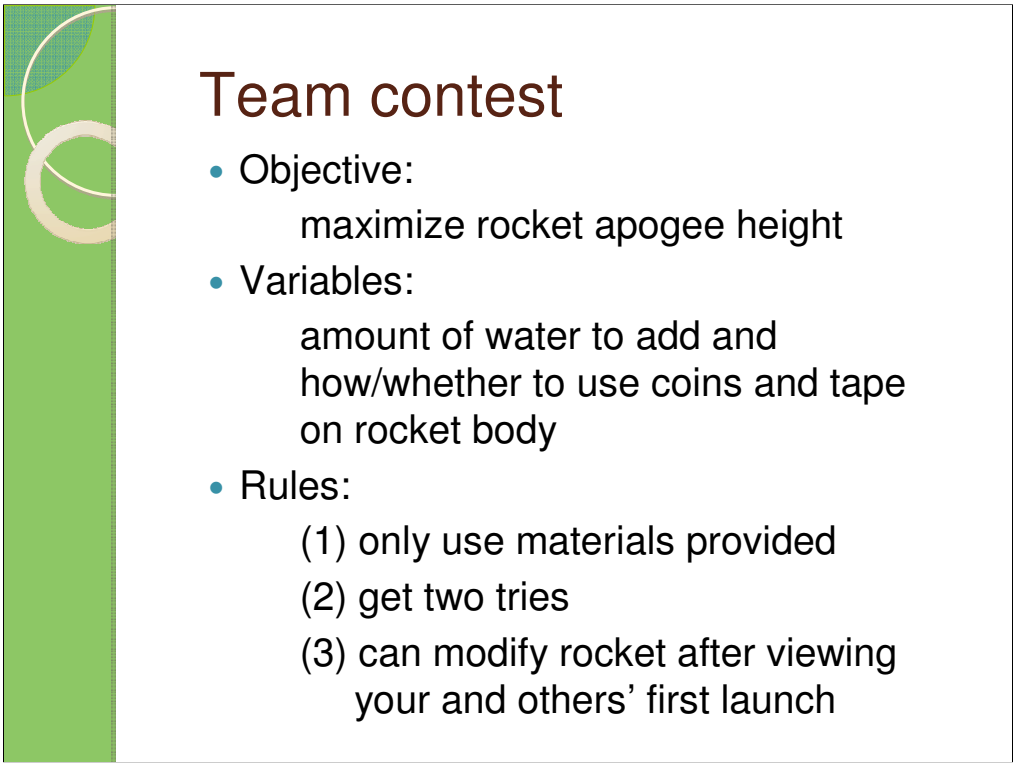
- empty 35mm film canister with lid (transparent kind)
- Alka-Seltzer tablet, broken into fourths
- water
- pennies
- masking tape



To launch a rocket, the canister is partially filled with water and the portion of the tablet is added. The lid is quickly snapped on and the rocket is inverted (lid on the bottom) and placed (normally) on a horizontal surface. After a minute or so the rocket will launch once the pressure is large enough to push the lid off. The pennies and tape can be used to modify the mass and the aerodynamics of the rocket body.

One source for film canisters is http://www.stevespanglerscience.com/product/flying-film-canisters

Ordinarily the launching platform is a bucket or plastic container sitting on the floor. However, the contest can be modified to have horizontal distance as the objective: mount a 250mL plastic graduated cylinder at a 45-degree angle and use as the launching platform, sort of like a mortar.



These rules are repeated at the end of the presentation

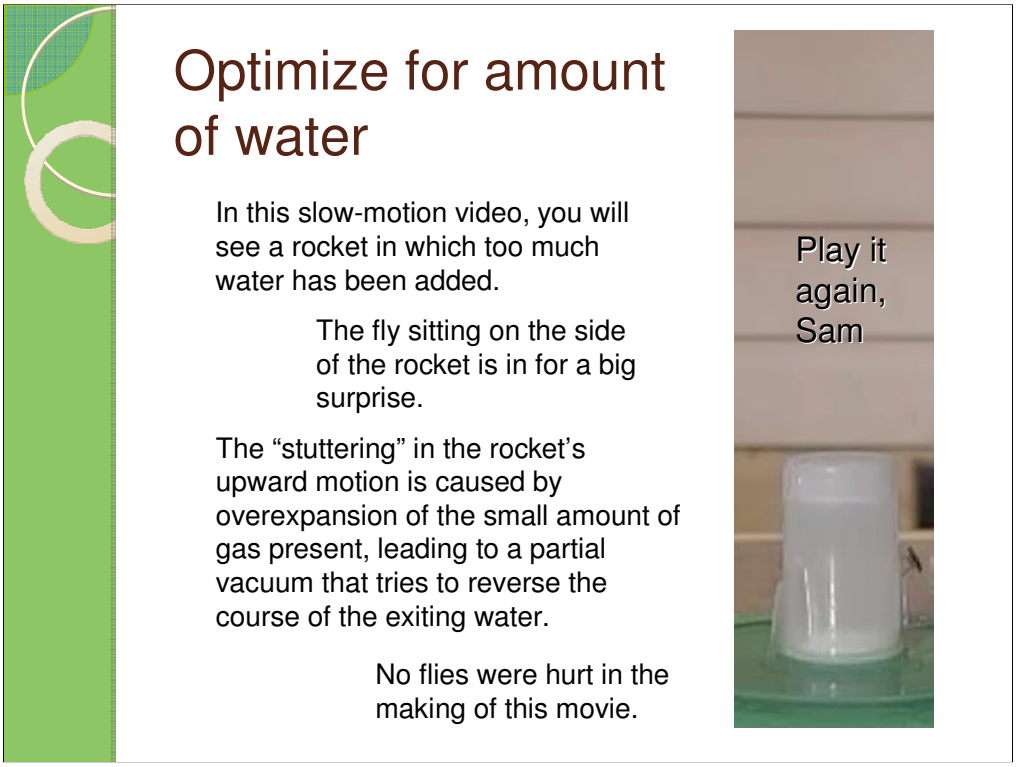
Optimization

- What, physically, leads to *one* particular set of conditions where maximum performance is achieved? (discuss)

- *Tradeoff*: competing needs or phenomena

  For example, the addition of more water to the rocket *increases* how efficiently the rocket produces thrust but *decreases* amount of stored energy (in the gas). There is a "sweet spot" where the amount of water leads to maximum overall thrust and thus maximum apogee height.

The water is a reaction mass that increases the efficiency of converting pressure energy (in the gas) to thrust and thus to kinetic energy of the rocket. If there is not enough water this efficient thrust will not happen. On the other hand, if you add more water to the rocket you are decreasing the volume of gas. Because the gas is the source of the pressure energy, you are decreasing the amount of energy stored in the rocket prior to liftoff. Thus, there is a tradeoff between these two effects.

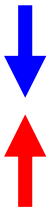


This slide shows (twice) a video of a rocket launch. The video was made at 1200 frames/sec using Casio EX-F1 camera and records 0.15 seconds. It was slowed down by a factor of 100 for playback. For the video to play, a separate movie file must be placed in the same folder as the Powerpoint file.

Optimize for added mass

How might added mass affect the rocket apogee height? (discuss)

Added mass *decreases* the rocket velocity following launch (harder to push it), but also gives the rocket more momentum to move through the air friction that opposes it (harder to stop it). There is a tradeoff between these two effects.



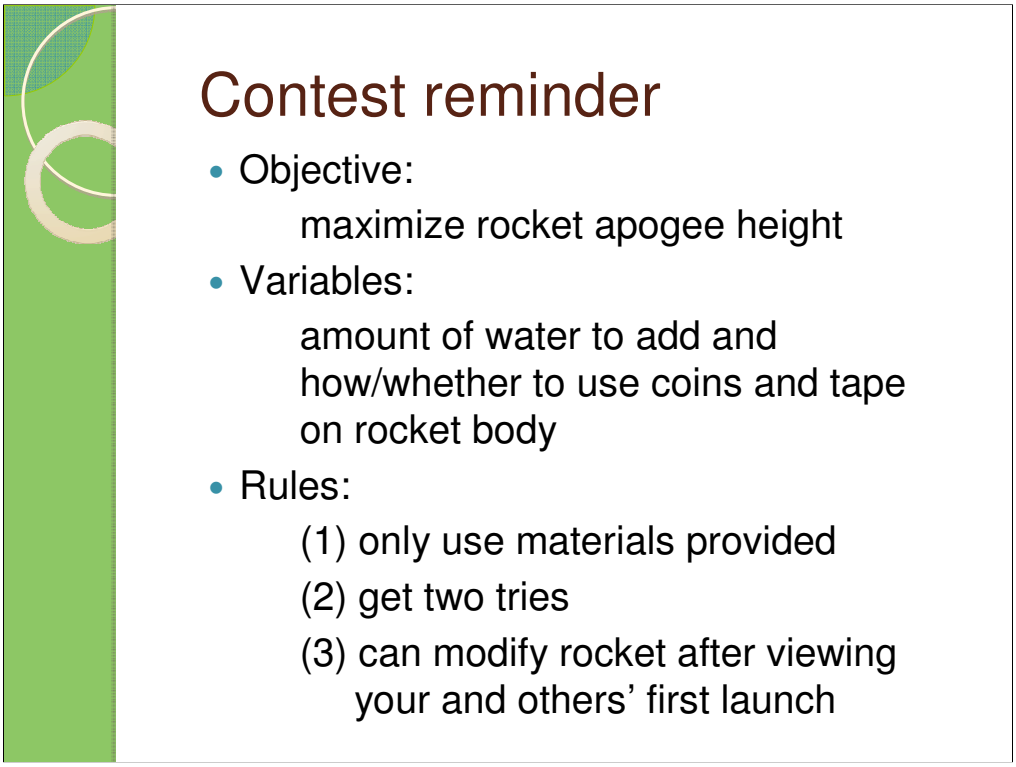
Depending on how the mass is arranged, it can also affect the amount of air friction on the rocket (streamlining and flight stability).

As another example, compare how far you can throw a ping pong ball vs. a golf ball. Both have similar size and aerodynamics. You can probably give the ping pong ball a higher initial velocity, but it rapidly loses speed due to having less momentum than the golf ball to push through the air resistance.

Design and build your rocket!

The contest starts in 8 minutes:

Spend a couple minutes discussing your design as a team and then build it.



Can leave this slide up while teams are working