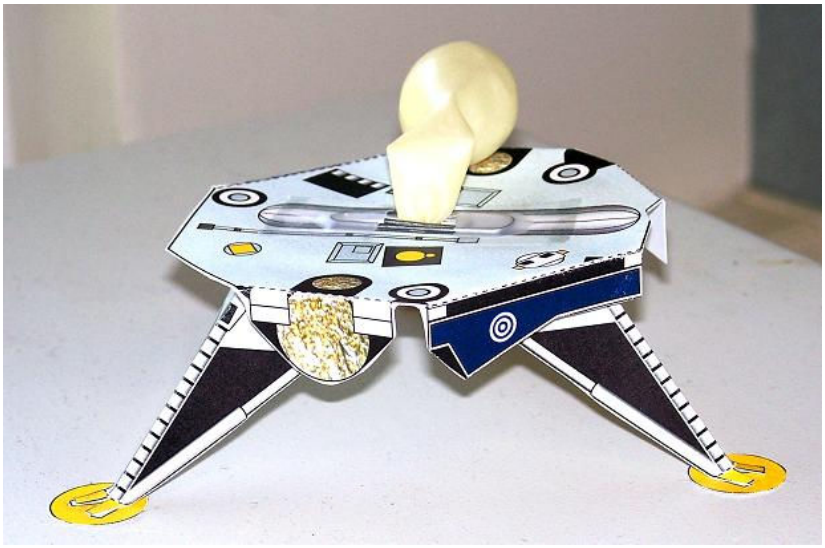
balloon powered Phoenix Mars Lander Model (simplified version)

by Steve Widmark
Mountain View High School, Mountain View, CA



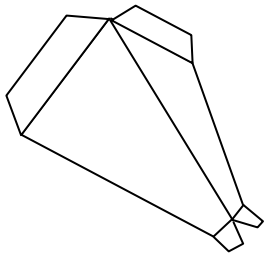
What is Phoenix?
Phoenix is NASA's latest mission to Mars. Launched on a Delta II rocket on August 4th, 2007, the Phoenix lander will touch down in the northern region of Mars on May 25, 2008. Once there, it will dig into the Martian permafrost using a robotic arm and analyze the composition of the soil and ice it removes with a sophisticated automated laboratory. In a nutshell, the goal of the mission is to determine if the Martian surface is (or was) capable of supporting life. Unlike the previous rover missions to Mars that made bounce landings using air bags, Phoenix will make a powered landing employing twelve thrusters positioned around the spacecraft. The model demonstrates this method of landing with a single balloon "thruster." For more information about the Phoenix mission go to http://phoenix.lpl.arizona.edu

Materials and tools:
1 parts sheet color printed on 110 lb (#110) card stock
1 balloon (lander flies best with a 5" balloon)
1 small paper clip
clear tape
glue sick or white glue
scissors
pencil

Directions:
Note: If the directions tell you to bend a tab down, this means to bend the tab down with the printed portion of the part facing up. If the directions tell you to bend a tab up, this means to bend the tab up with the printed portion of the part facing up. The front side of a part is the side with the printing. The back side of a part is the side without any printing.

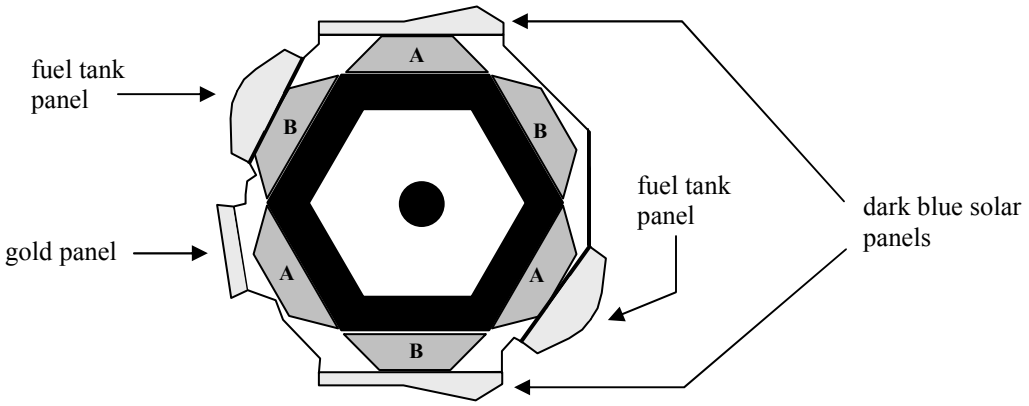
1. Cut out the **lander bottom** from the parts sheet. Cut out the small black hole in the center of the part or poke out the hole with a pencil.

2. Cut out the three **landing gear legs**. Cut along the short black line at the tip of each part. Bend the four tabs on each **landing gear leg** up along the dotted lines. Fold the **landing gear legs** in half length-wise.

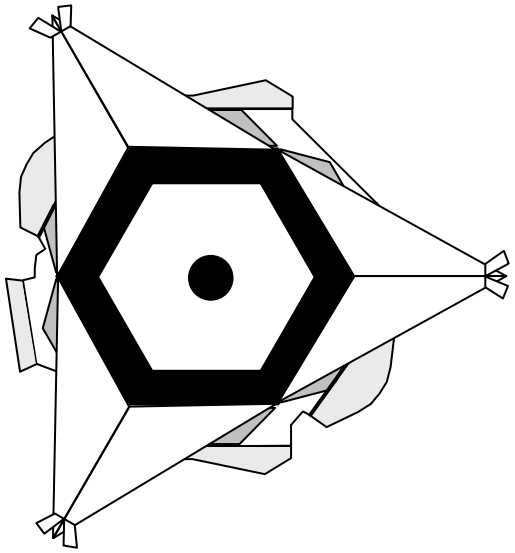


3. Cut out the **science deck** from the parts sheet. Cut out the black hole in the center of the part or poke out the hole with a pencil. Bend the four tabs down along the dotted lines.

4. Place the **science deck** on your work table with the printed side facing down. Put some glue on the back of the **lander bottom**. Attach the **lander body** to the **science deck** so that the holes in each part are lined up **exactly** and the **lander** bottom is oriented as shown in the figure below.

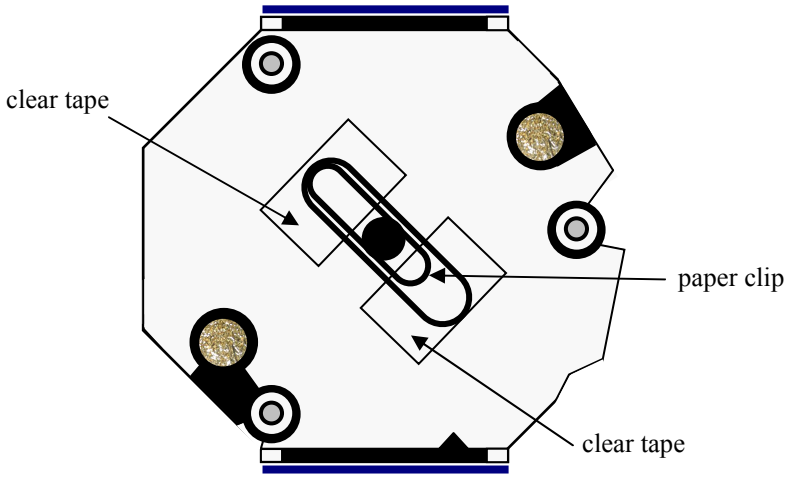


5. Put some glue on the back of the two white tabs on one of the **landing gear legs**. Attach the leg to the **lander bottom** so that the **A** and **B** tabs on the leg are attached to the A and B tabs on the **lander bottom**. Repeat this step for the other two legs so that the bottom of the lander looks like the figure below.

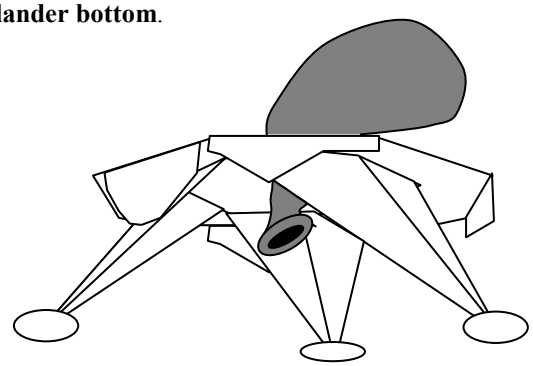


6. Cut out the three **landing gear pads**.. Put some glue on the back of the small yellow tabs at the tip of each **landing gear leg**. Attach each pad to each leg so that the shaded region on each pad is covered by the yellow tabs on each leg.

7. Using clear tape, attach the small paper clip to the top of the science deck as shown in the diagram below.



8. Inflate the balloon to maximum size and then deflate it at least five times to stretch it out. Poke the nozzle of the balloon through the paper clip and hole in the **science deck** with the pencil so it looks like the diagram below. Pull the balloon up so that the nozzle of the balloon lies flat against the **lander bottom**.

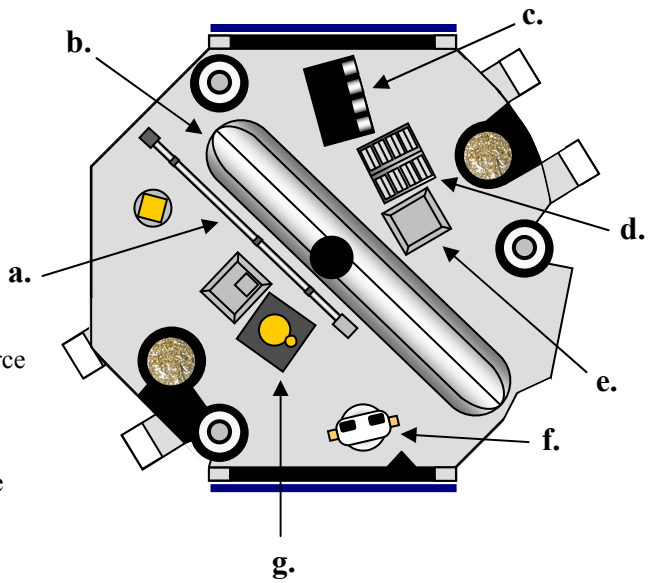


Flying the lander:
Inflate the balloon. Trial and error will determine how much air to put into the balloon. A well-stretched balloon inflated to maximum size seems to work the best After inflating, put your thumb over the end of the balloon to keep the air in. Hold the lander up over your head (or stand on a chair). Release the lander in a level attitude. Ideally, it should make a powered descent all the way to the ground and land upright on its landing gear. If it does not, try the following:

1. Put a different amount of air in the balloon
2. Release it from a different height
3. Add a small amount of weight (such as clay) to each landing gear pad.
4. Try a different sized balloon.

Enjoy!

Instruments on the Phoenix science deck



a. Meteorological Station (MET) boom
Measures surface temperatures, wind speeds and pressures.

b. Robotic Arm (RA) in protective cover
Delivers soil and ice samples from the surface to the TEGA and MECA instruments

c. Microscopy, Electrochemistry and Conductivity Analyzer (MECA) Wet chemistry lab with optical and electron-force microscopes.

d. Thermal Evolved Gas Analyzer (TEGA)
Determines the composition of soil and ice samples from the surface By measuring the power needed to vaporize the samples.

e. Mass Spectrometer
Determines the composition of soil and gas samples vaporized in the TEGA.

f. Surface Stereo Imager (SSI)
Provides stereoscopic, high resolution images of the surface,

g. MET Light Detection and Ranging (LIDAR)
Uses a laser to measure the size and distribution of particles in the atmosphere.

Steve Widmark
Mountain View High School
Mountain View CA

Additional copies of this model are available at www.paleoneon.com
My e-mail: steve@paleoneon.com

Parts Sheet

Balloon Powered
Phoenix Mars Lander Model (simplified version)

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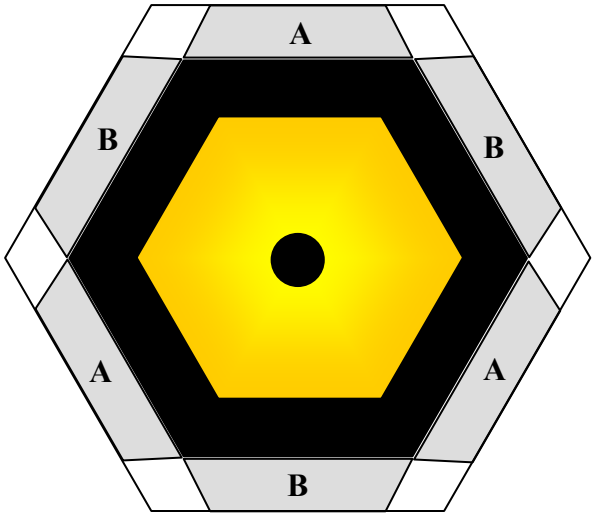
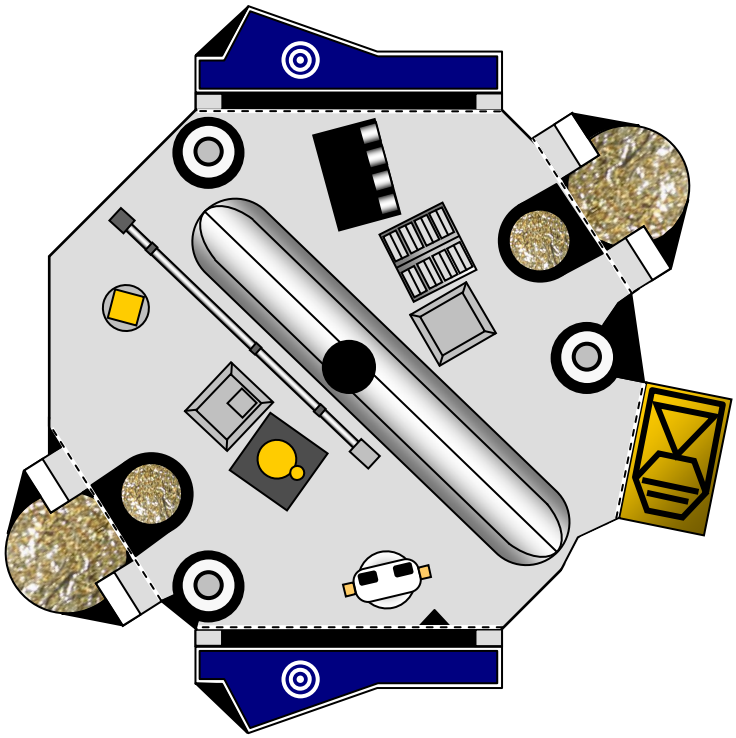
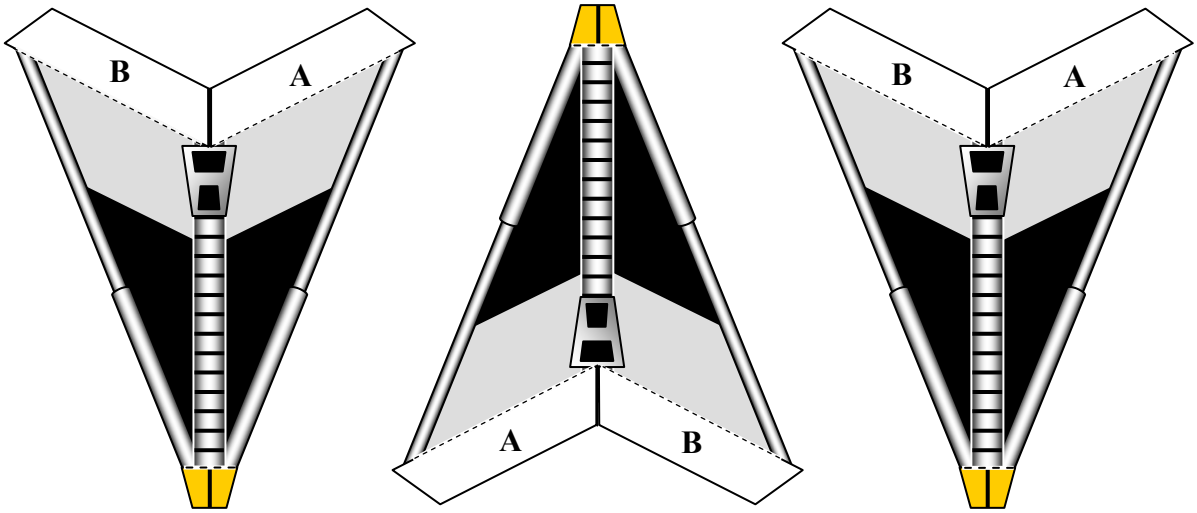
landing gear pads



lander bottom



science deck



landing gear legs