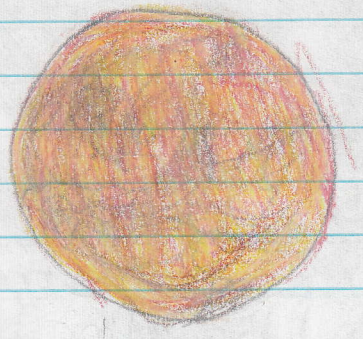
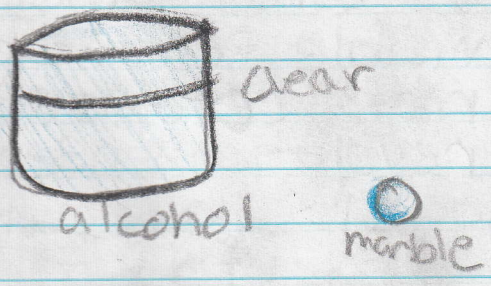
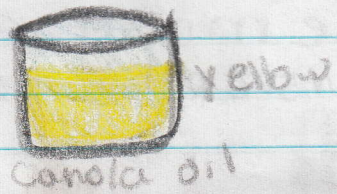
1/16/13

Exploring the Solar System

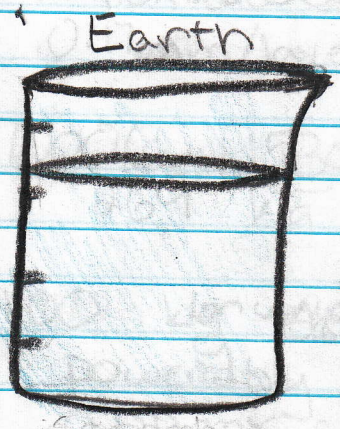
Learning Target: Identify characteristics of Venus and Jupiter that engineers would have to consider when designing vehicles to explore their surface

Drawings	Notes
 Earth	mean temp = 15°C atmospheric pressure (bars) = 1.013 atmosphere = 77% nitrogen 21% oxygen 2% other Gravity = 1
 Venus	mean surface temp - 482°C atmospheric pressure (bars) = 92 atmosphere = 96% carbon dioxide 3+% nitrogen less than 1% other (sulfuric acid) Gravity = 9.2
	the marble bounced + traveled very fast ex. Earth
	traveled slower than the alcohol, didn't bounce, softer sound venus

Venus Probe

Venus

Surface-
mean temp.: 482°C
gravity = .9 × Earth
Atmosphere-
pressure (bars) =
96% carbon dioxide
3+% nitrogen
<1% other (inc. sulfuric acid)
high temp = 460°C (melts lead)



Earth

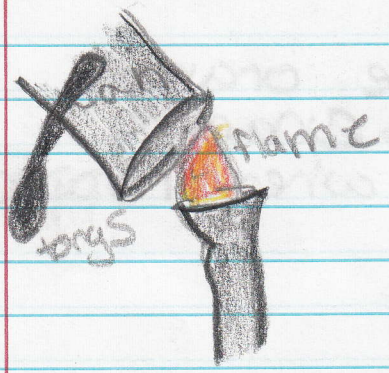
Venus

marble

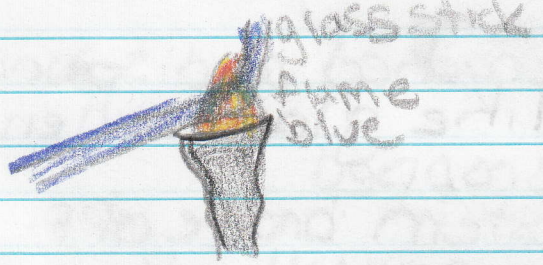
rubbing alcohol	cooking/ canola oil
• marble fell very fast • bounced on the glass bottom	• was slower than the alcohol • made noise on the bottom, but didn't bounce

• rotates opposite other planets
• Sunlight reaches surface
• Volcanoes with lava flows, craters, and domes

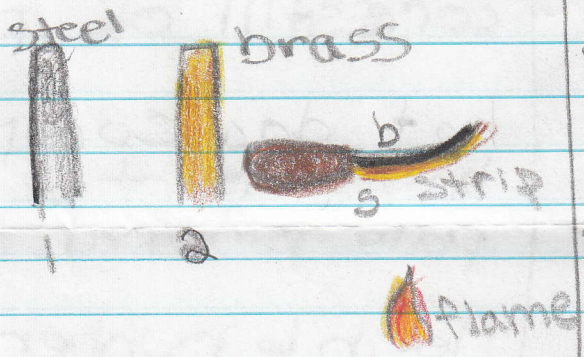
Venus conditions



the aluminum can melted + dripped off on to the table
flame = 600°C
the tongs squezzed + squished the can
steam came out the top flame on can

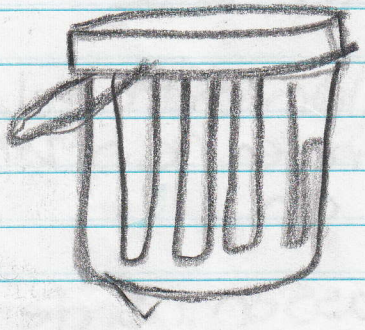


the glass bent and there was orange flame around it
glass = silica



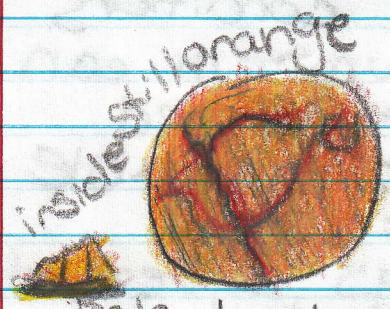
the strip bends because the brass expands more than the steel
the steel is black

mean temp = -121°C
atmospheric pressure(bars) = 0.7
atmosphere:
90% hydrogen
10% helium
Gravity = 2.5



liquid nitrogen causes water to freeze and expand
kills cells permanently

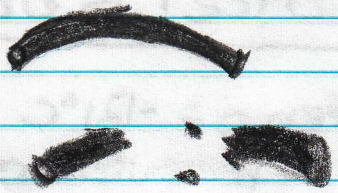
Jupiter Conditions



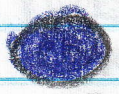
is pale orange
makes cracking
sound when dropped

cracked and sounded
like glass when
dropped
stem broke off
core still ok pale

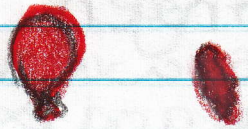
hot dog compleately
broke apart
pale pinkred



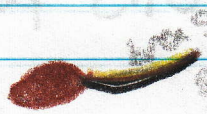
flexible rubber
tubing black, hollow
after dark
inflexible, snaps
like hard plastic pale



raquet ball
sounds like a golf
ball when dropped
paler blue



ballon deflated in
nitrogen, re inflated
in air



brass on inside

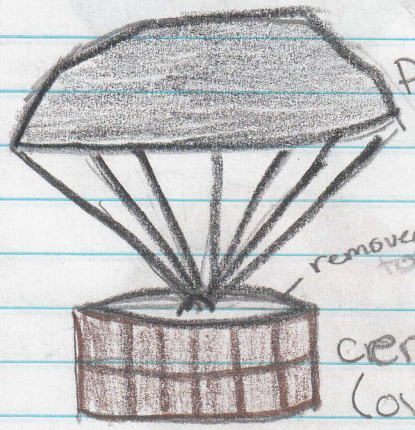
Venus Probe

requirements

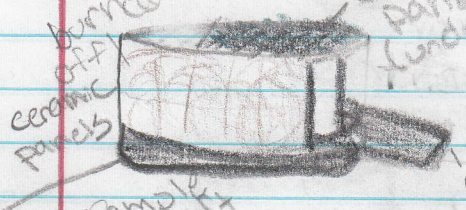
- camera
- thermometer
- rock + air + other sample collector
- rover (mobile)
- able to get off planet again
- soft landing
  - + safe, heat sheild
    - parachute
    - sulfuric acid resistant
    - able to withstand a wide array of temp

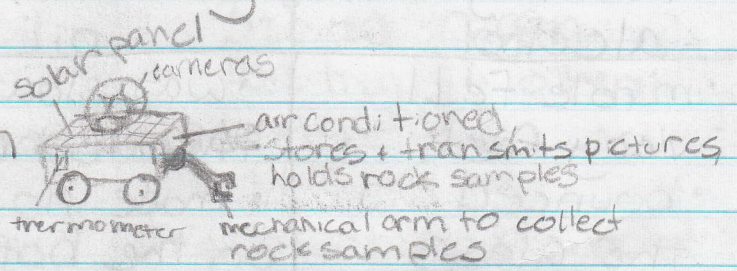
az + the power to get off planet

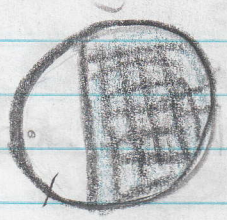
layer of cool air between solar panels



side



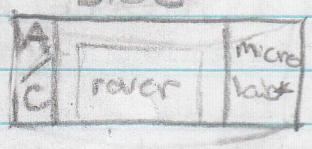




solar panel with clear ceramic cover, layer of cool air between cover + panel

hatch (opens when the rock sample is taking off

side

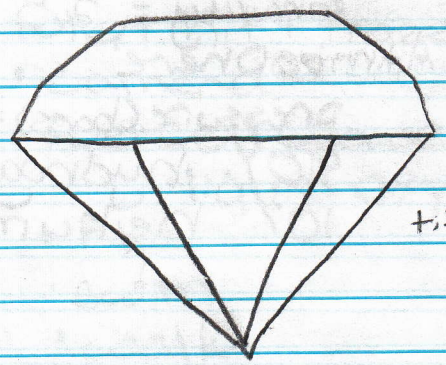


*micro lab ananlyzes rock samples

weight of spacecraft: 17,000kg

5x denser than Earth

Parachute-



* a flexible ceramic material with gold backing
0.17mm/layer 0.15 kg/m² (for 10 layers)

17000(Earth), 15300(venus) kg probe velocity ≈ 0.5m/s
269 kg parachute

100 kg sample craft
powered by thermal nuclear propulsion
approx. size of a large suitcase (3×2×2)

ZircoFlex Gold inflatable shell on bottom

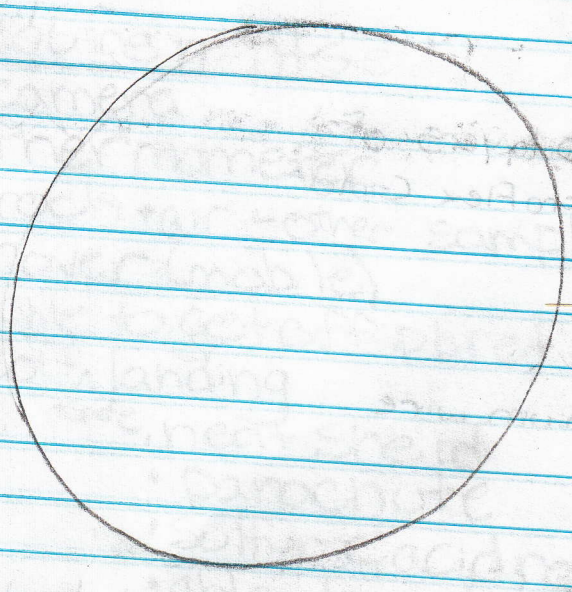
carbon composite tiles

cameras* surrounded by a clear ceramic, solar panels

All interior structures (rover, lab, arm) have a layer of cool air in between covering and inner mechanics

Air conditioning - more research needed to be feasible.

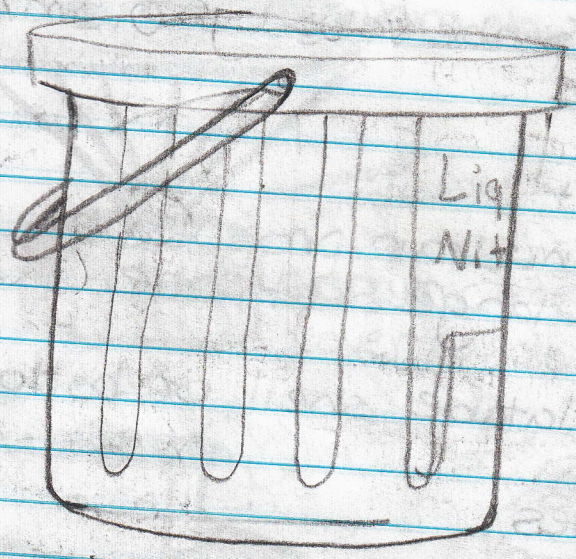
Jupiter



Surface:
- mean temp = -121°C
- Gravity = 2.5

Atmosphere
- pressure (bars) = 0.7
- 90% hydrogen
- 10% helium

- Atmosphere is gas
- changes to liquid
- possibly a solid core



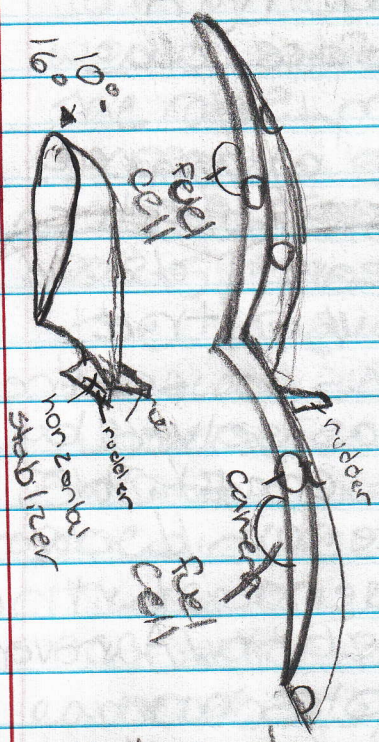
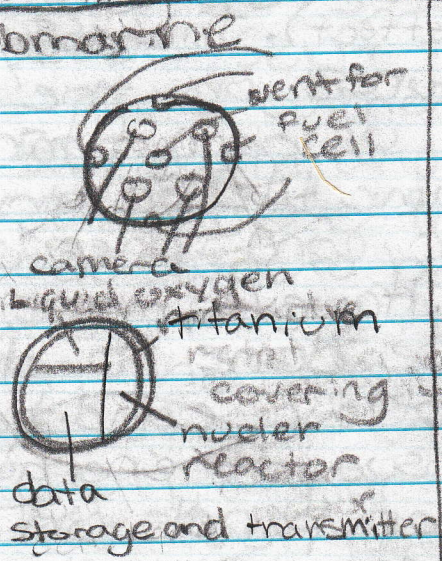
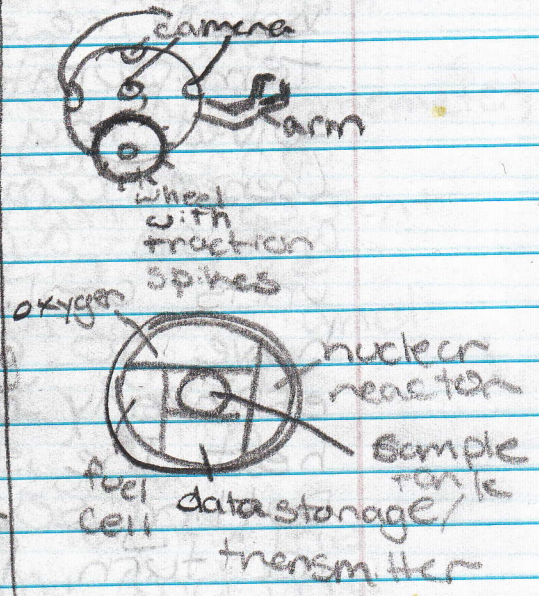
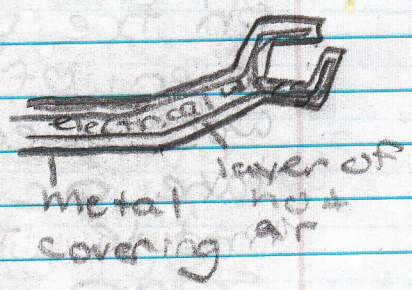
liquid nitrogen
- similar to conditions on Jupiter
- froze orange, banana, hotdog, brass, steel, air, and rubber tubing

Jupiter Probe

great red spot = hurricane

Requirements

- doesn't contract much (freeze) or break when hit + frozen
- camera
- fuel cell (power)
  - liquid oxygen
- fly
- swim
- walk
  - go to possible solid core
- bring samples back?
- thermometer

Flying rover	Swimming rover	Land rover
	• submarine 	
material: titanium radioactive metal?	camera with ceramic covering nuclear heat	

Venus Probe

An half-melted surface, an average temperature of 482°C, gravity almost identical to Earth's and a 96% carbon dioxide atmosphere. These are all things a probe to Venus would encounter. The probe would have to have cameras, a thermometer, a sample collector, a rover, a soft landing, and a capsule to send samples to Earth. Normal materials couldn't be used to build a probe because of the extreme heat. The parachute, slowing down the probe's desent could be smaller because Venus's atmospheric pressure is about 92 times that of Earth (gravity is almost identical, virtually no effect). The issues of high temperatures on the surface was solved by using a titanium skin (beneath ceramic tiles for entry into atmosphere) and an air conditioner to keep electrical units cool. However, more research would have to be done to discover the efficiency of air conditioners in extreme heat. The issue of energy was solved by putting solar panels on the craft. This, in turn, lead to a clear ceramic covering on the panels and all cameras, with a layer of cool air underneath. A rover was used to collect samples and take pictures. Just like the main module, the rover had an air conditioner, solar panels, and a transmitter to send data back to Earth. The final

issue was sending rock samples back to Earth. A small rock container was launched from the main modual, powered by thermal nuclear propulsion. Although sending a probe to Venus may not be fesible yet, with research, it is possible.

Jupiter Probe

Jupiter's average temperature is -121°C, its gravity is 2.5 times Earth's, its atmospheric pressure is 70% of Earth's, and the atmosphere is 90% hydrogen, 10% helium. A probe sent to Jupiter would have to have cameras, a thermometer, the ablity to fly, swim, and walk, send samples back, and be extremly resistant to cold. The probe would be in three parts, the "plane", the submarine, and the land rover. The "plane" would be two curved wings (⌒) with rudders (for control), a horizontal stabiler, and two fuel cell tanks. The shell would be titanium and the interior would be heated via nuclear reaction. There would be multiple cameras with clear ceramic coverings and a data transmitter to send pictures to Earth. To make to fuel cells work, a large tank of oxygen would be brought. The submarine

rover would also have a titanium shell (very temperature resistant), only it would be sphere shaped. Again, there would be multiple cameras (with clear ceramic covers), nuclear heat, and a data transmitter. There would also be multiple outlets for the fuel cell's energy so that the submarine could be controled, although it would mostly go with the flow of the water. The land rover would pass straight into the core of Jupiter. If it didn't hit land, it would stay in the center of it until it was crushed or frozen. If it did hit "land" it would move by using spiked titanium wheels (grip on ice). The man body would be a sphere because the extreme gravity would have difficulty crushing it. There would be multiple clear ceramic-covered cameras, a tank of oxygen, fuel cell batteries, and nuclear heat. A titanium "arm" would have a layer of heat between the metal shell and the wiring, and it would pick up samples to send back to Earth. The thermal nuclear propulsion system would send the samples back to Earth.

Exploring the Solar System

Name Kate Sottilare
Date 1/23/13 Period 6 Score 3.8/4

	4	3-READ FIRST!	2	1
Drawing with captions **Venus Demo** 3/4	__ Exceptional details are included Additional information/notes would include information about: __ how the density of the atmosphere would affect entry of a probe __ what surface conditions could/would affect a robot attempting to explore the surface __ at least 2 additional details	Each step of the demo is drawn and explained. The explanation includes a description of what exactly is being modeled by the demonstration. X Heating the can X Heating the glass	1 portion of the 3-proficient response is missing or incomplete	2 or more steps of the demo are incompletely recorded
6 **Drawing with captions** **Jupiter Demo** 3/4	__ Exceptional details are included Additional information/notes would include information about: __ how the density of the atmosphere would affect entry of a probe __ what surface conditions could/would affect a robot attempting to explore the surface __ at least 2 additional details	Each step of the liquid nitrogen demo is drawn and explained. The explanation includes a description of what exactly is being modeled by the demonstration. X Banana X Rubber tubing X Super/racquet ball X Balloon X Bimetallic strip	1 portion of the 3-proficient response is missing or incomplete	2 or more steps of the demo are incompletely recorded
Paragraph 1 Venus Probe Design 4/4	In addition to 3-proficient topics the paragraph should include: X effects of high atmospheric pressure X advanced discussion of materials and design issues that would be encountered X clear evidence of research beyond the material presented during the demonstration	Basic design criteria that would be necessary to overcome: X Excessive heat __ Molten surface X Basic discussion of material requirements	1 portion of the 3-proficient response is missing or incomplete	2 or more portions of the 3-proficient response is missing or incomplete
Paragraph 2 Jupiter Probe Design 3.75/4	In addition to 3-proficient topics the paragraph should include: __ effects of low atmospheric pressure X advanced discussion of materials and design issues that would be encountered X clear evidence of research beyond the material presented during the demonstration	Basic design criteria that would be necessary to overcome: X Excessive cold X Fluid "surface" __ Basic discussion of material requirements	1 portion of the 3-proficient response is missing or incomplete	2 or more portions of the 3-proficient response is missing or incomplete
14 **Paragraph 3 Evaluation of Venus Model** 3/4	Advanced critique of the model would include all of the criteria for a 3-proficient response and at discuss least 3 additional topics. These could include: Model did not represent __ Dense cloud cover __ Limited vision __ Volcanic eruptions __ Gravity __ Day length __ Seasons __ Weather	These positive aspects discussed X Heating can represent extreme temperatures X Heating glass represents molten surface X Sulfuric acid represents atmospheric conditions X Bimetallic strip represents heat extremes on metal At least 1 negative aspect should be discussed X Atmospheric pressure not demonstrated X Contents of the atmosphere (mostly carbon dioxide) not modeled __ other (specify)	1 portion of the 3-proficient response is missing or incomplete	2 or more portions of the 3-proficient response is missing or incomplete
Paragraph 4 Evaluation of Jupiter Model 3.25/4	Advanced critique of the model would include all of the criteria for a 3-proficient response and at discuss least 3 additional topics. These could include: Model did not represent __ Dense cloud cover __ Limited vision __ Liquid surface X Gravity __ Day length __ Seasons __ Weather	These positive aspects discussed X Banana represents food issues X Balloon demo shows extreme affect on gases X Rubber tubing / super ball / racquet ball representing extreme cold on flexibility X Bimetallic strip represents cold extremes on metal At least 1 negative aspect should be discussed X Atmospheric pressure not demonstrated X Contents of the atmosphere (mostly hydrogen) not modeled __ other (specify)	1 portion of the 3-proficient response is missing or incomplete	2 or more portions of the 3-proficient response is missing or incomplete

Total 20/6 Average (Total ÷ 6) Round to nearest 10th: 3.3