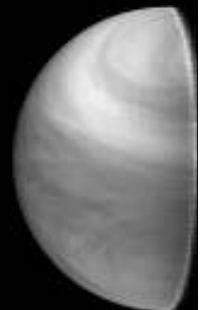


Venus Express Education and Public Outreach

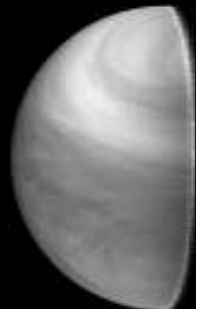


Sanjay Limaye for
Rosalyn A. Pertzborn
Space Science and Engineering Center
University of Wisconsin-Madison
Greenbelt, MD
4 November 2007



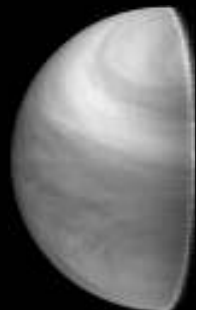
Venus Express E/PO Program

- Sponsored by NASA, Coordinated with ESA
- First international E/PO Pilot program between NASA and ESA
- Joint efforts providing useful experience and new opportunities
- Your participation?



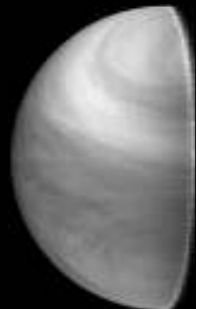
Efforts to Date: **Informal Education**

- Education and Outreach Workshop for scientists at Europlanets, Berlin, September 2006
- Hows and Whys - Kiosk Presentation at Great Lakes Visitor Center, Ashland, Wisconsin - May 2006
- Hows and Whys - Kiosk Presentation at Great Lakes Visitor Center, Ashland, Wisconsin Milwaukee Public Museum - February 19, 2007
- Venus Express E/PO Workshop for Science communicators at the Planetarium of the Royal Observatory of Belgium, Brussels - April 2007



Efforts to Date: **Formal Education**

- Curriculum module development - two modules under testing
- Venus Express outreach workshop for teachers - Belgium Institute for Research in Aeronomy (BIRA), September 2006
- Astronomy 101 - Venus lecture (David Grinspoon) at DPS 2006 - 13 October 2006, Pasadena, California
- Workshop for Teachers and Informal Education presenters - Planetarium of the Royal Observatory of Belgium - 26 April 2007
- Student Training
 - Graduate Student: Hsuan-Yun Pi (Curriculum, Web)
 - Undergraduate Students - Megan Evensen (Cloud Motions)
 - Christie Taylor (Outreach)



Unsolved Mysteries of Venus Curriculum for upper secondary students

Screen 1 of 43

The Unsolved Mysteries of Venus



Curriculum Outline

Module1: Understanding Remote Sensing (how are images created)

- Images comparison (IR, VIS, and UV)
- Radiation Spectrum (wavelength)
- How does a camera work (optional -- advanced)

Module2: Atmosphere Structure Dynamics Observation (Image Data)

- Image Comparison – Earth's hurricane vs. Venus's double-vortex

Screen 2 of 43

- Clouds tracking – reading graphs (longitude & latitude) and calculating wind speed (velocity)
- Rotation rate (optional-- advanced)

Grade Level

Grade 8-12

Overview

The purpose of this unit is for students to apply their newfound knowledge in order to investigate the complex global atmospheric dynamics and cloud system of Venus, Earth's sister planet, using actual Venus Express (VEX) data. The activities will employ imagery taken from the orbiter instruments on Venus Express spacecraft. Students will investigate and analyze images generated by several onboard cameras including: Venus Monitoring Camera (VMC); Visible/Ultraviolet/Near-infrared Mapping Spectrometer (VIRTIS); Ultraviolet and Infrared Atmospheric Spectrometer (SPICAV/SOIR). Students will also be introduced to the use of remote sensing in atmospheric and space science.

Guided by the science inquiry based instructional methods The activities stimulate the process of how scientists perform research by 1) asking questions, 2) testing their ideas, 3) analyzing data about a planet and an atmosphere that can not be measured directly.

Background Information

About Venus Express:

Venus Express is ESA's first mission to Earth's nearest planetary neighbor, Venus. The Venus Express spacecraft was launched from the Baikonur

Sample Curriculum Activity: Hurricane on Venus? Continued...

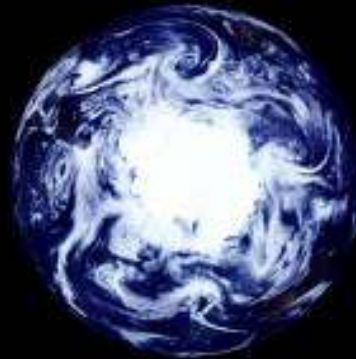
Materials

Present students with three Images: Hurricane Katrina (A), South Pole Projection of Earth (B), and Venus South Pole Vortex (C)

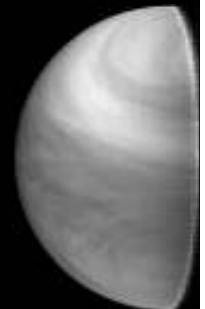
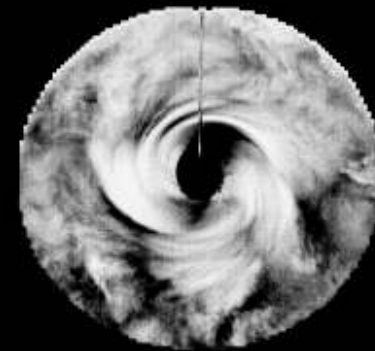
A: Hurricane Katrina
(0828_2005_1700)



B: South Pole Projection of Earth
(Galileo)



C: Venus South Pole Vortex
(Mariner10)



Sample Curriculum Activity: Hurricane on Venus?

Essential Questions

1. Based on the images provided, what does Venus have in common with Earth?
2. Based on the images provided, how does Venus differ from Earth?

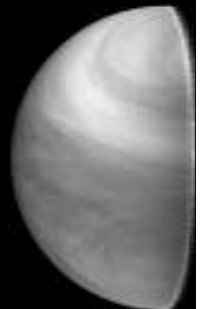
Key Concepts

1. Venus has hurricane wings and huge atmospheric vortexes recycling over its poles.
2. Venus rotates from East to West (counterclockwise if looking from south pole), which is just the opposite of Earth.

Objectives

Students will:

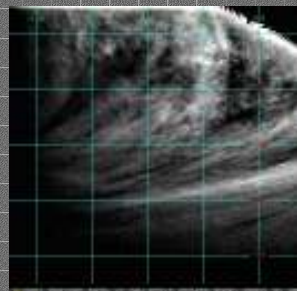
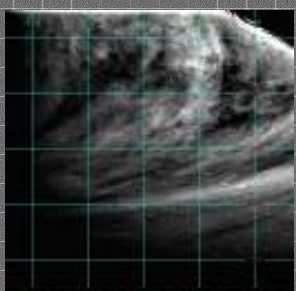
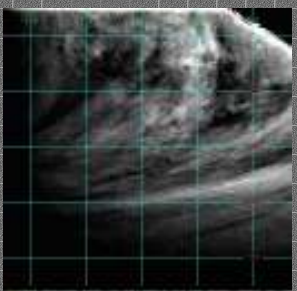
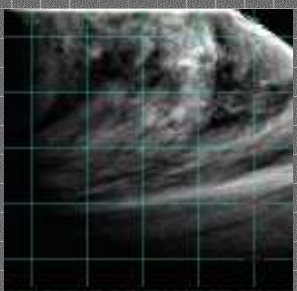
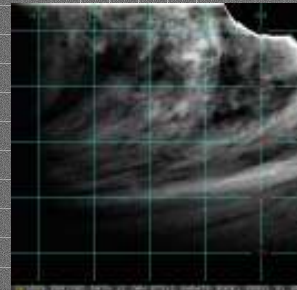
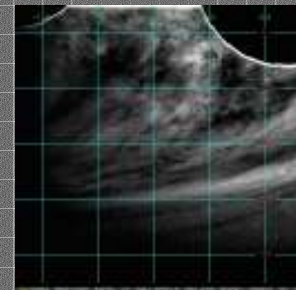
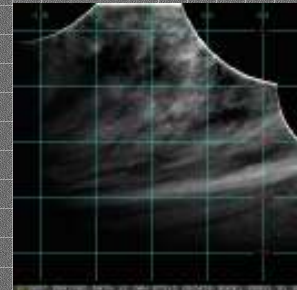
1. Discover Venus's massive hurricane-like vortex over the south pole.
2. Discover that Venus rotates from East to West, which is the opposite of Earth.

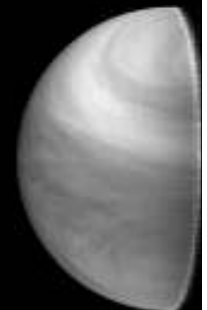


Sample Curriculum Activity: Winds on Venus.....

Materials

A set of 7 time sequenced images of Venus's cloud features. These images were taken on January 12, 2007 and are mapped into 20°x 20° latitude-longitude grid coordinates. Print these images in the correct time sequence on a letter size paper.

			
1) UT 03:34:39	2) UT 03:54:39	3) UT 04:14:39	4) UT 04: 34:39
			<p><i>UT = Universal Time</i> Times given in UT are almost always given in terms of a 24-hour clock (hh:mm:ss). Thus, 14:42:03 (often written simply 144203) is 2:42 and 3 second p.m.</p>
5) UT 04:54:39	6) UT 05:14:39	7) UT 05:34:39	



Sample Curriculum Activity: Tracking Clouds on Venus

Essential Questions

1. How fast do clouds move in the surface of Venus's atmosphere?
2. How do scientists measure and calculate the wind speed and direction in the surface of Venus's atmosphere

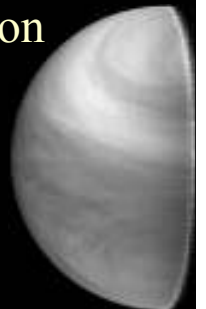
Key Concepts

1. Latitude and longitude are coordinates in a system designed for locating a point on the surface of a sphere.
2. Scientists measure wind speeds on Venus by tracking the motion of features within the cloud bands over time.

Objectives

Students will:

1. Demonstrate the ability to read the value of latitude and longitude of a point on Venus's image mapped with coordinates
2. Identify cloud features, measure and compute the distance traveled in two point of time and compute the wind speed

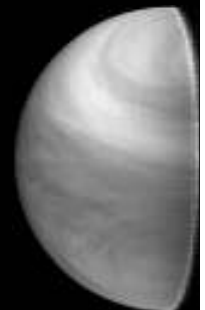


Curriculum Evaluation

9-12 grade science teachers from Madison, Wisconsin

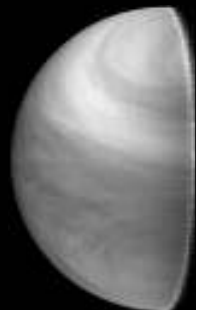
	Criteria	Average
1	Objectives clear and appropriate for group.	3.67
2	Motivating effective for the students.	3.33
3	Questions asked effectively stimulate and guide students' thinking and problem-solving.	3.5
4	The students actively engaged in this activity.	3.5
5	Lesson logically and sequentially organized.	3.5
6	Visual aids and worksheets appropriate for the activity.	3.67
7	Inquiry-based instructional methods.	3
8	This activity is easy to implement.	3.67
9	I would use this lesson plan in my classroom.	4.5

(5= strongly agree and 1= strongly disagree)



Teacher Comments: Curriculum Strengths

- The comparisons are interesting and specific, and showing the pictures without the labels is an interesting form of inquiry. (Module 2. activity 1: Hurricane on Venus?)
- This is real data! That is so exciting for students to do “real science” with real data. Let the students know they are doing science! Yay!
- Using actually current data and involving students in teams to make sense of data. Has applicability to other areas of science using key question #1: In what other areas of science do scientists study things they can't touch/ directly observe, etc?



Teacher Comments: **Weaknesses**

- Get students connected with what they already know, (earth science, weather comparisons)



Teacher Comments: What would you do to improve this lesson?

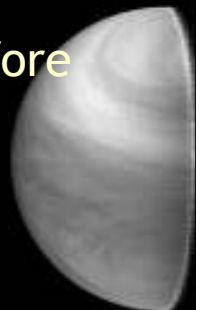
- Background knowledge. Understanding Earths' rotation. Explanation on the cause of the huge storm at the pole of Venus.
- Ask students questions about how they think we know what we know about planets that are so far away
- Ask students can they think about their own experiences with objects at home and whether or not the objects are hot or cool (like a stove, ice, fire in fireplace) and have them tell what colors they might link with those objects - such as red for hot etc.
- I would ask students to all write a response to the question, "How do you think scientists could study an object like a planet that they cannot touch?" This is addressing students' prior knowledge.



Teacher Comments:

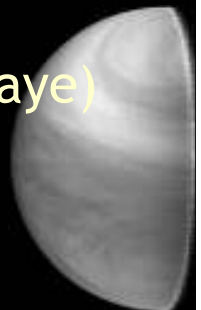
What would you do to improve this lesson?

- Show students all of the data at once (maybe even comparable data for Earth), then have them generate questions about what we can learn about Venus (What do we want to know about Venus) based on preliminary viewing of the data. I bet that the modules would emerge just from students questions/comments. This could then be your lead in to nature of scientific inquiry.
- Have all students pair and share their answers with a partner from another group before presenting ideas to the whole class.
- Have group norms or scientific community norms explicitly displayed that all students in your class are always working toward.
- It'd be good to add in idea about coloring or guessing temperatures before giving them info.



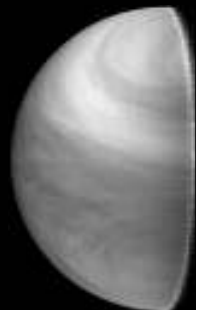
Efforts to Date: **Public Outreach**

- Launched Amateur observations of Venus in UV and IR through ALPO and BAA - April 2006
- Collecting amateur images since June 2006 and posting them on the web
- Web Page launched - April 2006. Updated ~ monthly
- EGU 2006 Venus Outreach Presentation - Vienna, Austria, April 2006
- Venus Express E/PO Paper at DPS 2006
- Presentation - Madison Astronomical Society, 9 February 2007
- EGU Presentation on Education and Outreach effort, EGU 2007
- Native Sky Stories conference at Lac du Flambeau reservation - April 2007
- Presentation at the Royal Observatory of Belgium, April 2007 (Limaye)
- Presentation at the Annual Meeting of the Association of Lunar Planetary Observers (June, 2007, Limaye)



Efforts to Date: **Web**


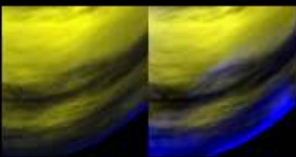
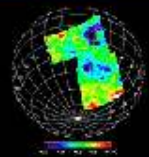
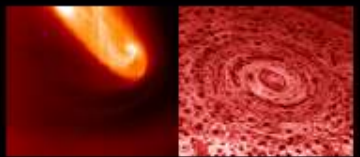
- venus.wisc.edu launched in April 2006
- Amateur Venus Image Archive page organized by date
- MESSENGER Venus Fly-by link added in May 2007
- Venus Express E/PO Events page
- Curriculum modules to be posted in the near future
- Scientist pages - TBD
- “Women of Venus Express” page to be launched soon to highlight science careers for young women
 - Anna Vandaele (SOIR/SPICAV, BIRA)
 - Valerie Wilquet (SOIR/CPICAV, BIRA)
 - Janet Luhman (UC-Berkeley)





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- What's New
- The VEX Mission
- Education
- About Venus
- Women of VEX
- Amateur Images
- Contact

Recent Data from Venus

			
Multiple views of Venus' clouds: VIRTIS (24 September 2006)	Zoom-in on Venus' oxygen airglow: VIRTIS (26 August 2006)	Temperature maps of Venus' surface: VIRTIS (10 August 2006)	Polar vortices at Venus and Saturn compared: VIRTIS (29 May 2006)

Welcome !!

On November 9th of 2005, Venus Express was successfully launched from the Baikonur Cosmodrome in Russia. Successful insertion into Venus' orbit took place on April 11, 2006 and data analysis is well underway. Venus Express achieved its desired orbit in May and has been sending routine data from its science instruments. Results are being announced as they become available. The mission is expected to provide data on the Venus atmosphere for several of the planet's days.

The Venus Express mission has many US participating and interdisciplinary scientists who are supported by NASA. With support from NASA, we are pleased to present the Education and Public Outreach efforts for Venus Express Mission in cooperation with the European Space Agency.

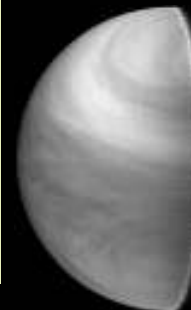
Venus Express News

MESSENGER flies by Venus on June 5 2007 !!

[... more](#)

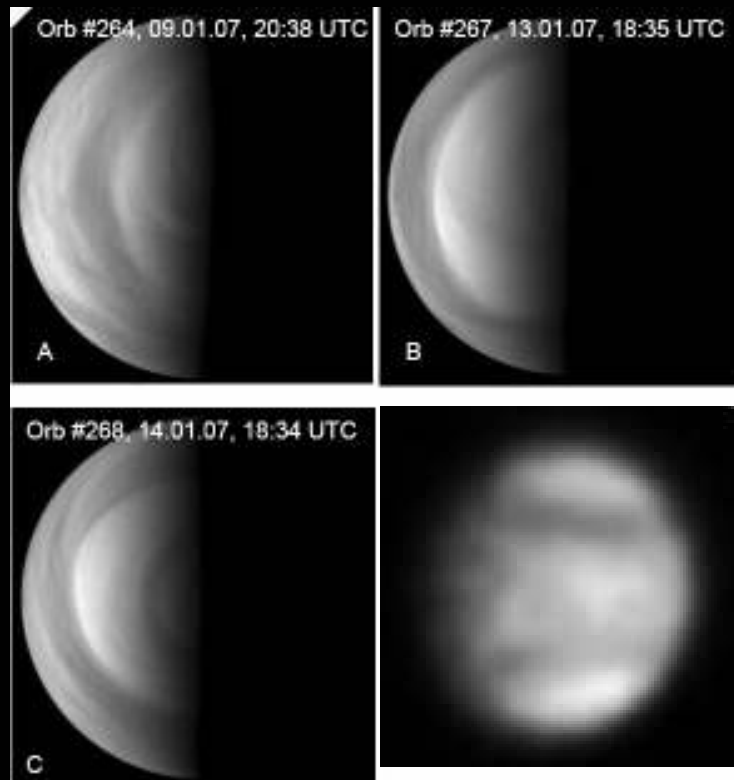
Gallery: Amateur Images of Venus

May 31, 2007

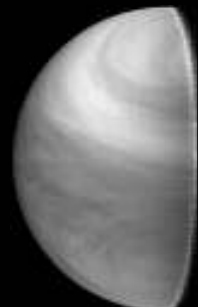


Amateur Imaging of Venus

- Venus southern hemisphere brightening captured in amateur UV image!

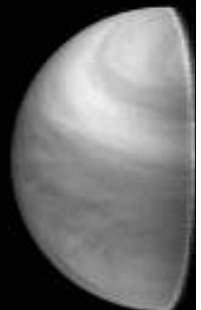


Dr. Don Parker,
Coral Gables Florida,
13 January 2007



Planned Future Efforts

- Web page updates, new material
- Amateur image archive
- Exploring programs at Denver Planetarium (Grinspoon)
- Support/Participate in Venus Day at ESOC
- Collateral programs:
 - Venus GCM/UCLA and Livermore Joint Unified School District (recently selected for funding!!)
 - Host Kiosk at Space Expo (Noordwijk, Netherlands) in cooperation with ESTEC/ESA (D. Merritt)
 - VESPER Discovery Mission Formal Education Partner (To be announced, Dec. 07)



Your ideas?

Contact:

rosep@ssec.wisc.edu

