



National Aeronautics and
Space Administration

Educator Product

Students

Grades 5-8

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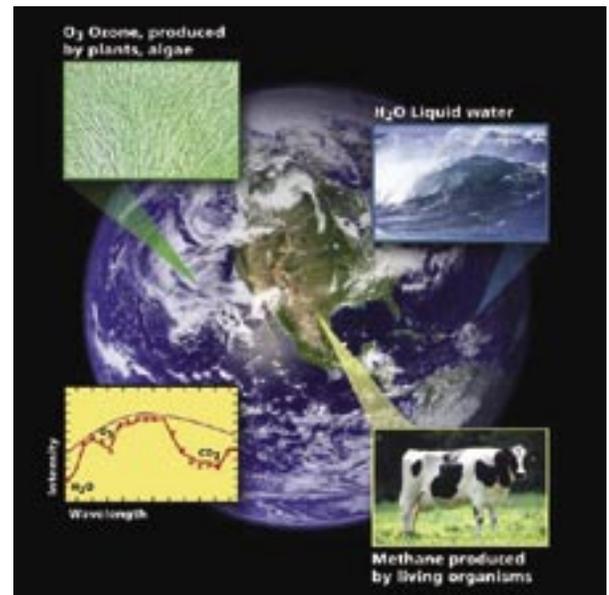
Educational Topic

The Virtual Planetary Laboratory

- Take one Earth-sized planet
- Add carbon dioxide, water vapor, and methane.
- Place in a circular orbit around a star like the Sun.
- Heat slowly for one billion years.

What do you get? **Life!**

Scientists have discovered over 100 planets outside of our solar system. These planets orbit stars like the Earth orbits the Sun, and scientists want to find out if any of them are living planets—planets that support life. We can't visit the planets or send spacecraft to them because they are too far away. So, NASA is planning to launch huge telescopes to search for life from a distance. To support this telescopic search for life, NASA is building a computer program called the Virtual Planetary Laboratory (VPL).



The VPL works like a planet-making machine that combines ingredients such as geology, climate, chemistry, and biology in all sorts of different ways to cook up computer-modeled planets. The VPL will help the team find out not only what a living planet might look like, but what non-living planets might look like as well.



Artist Conception of VPL Workstation

For additional information on the Virtual Planetary Laboratory, visit:

<http://vpl.ipac.caltech.edu/>

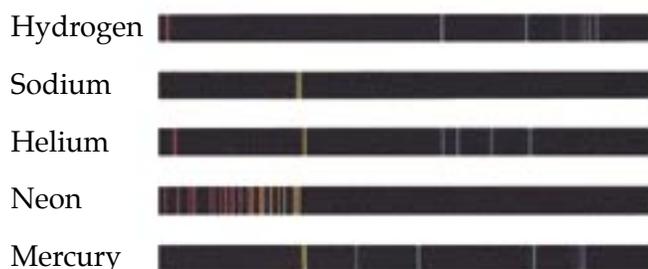
The VPL research program is a team effort between twenty-one scientists from seven universities and research institutions who share their resources and knowledge. Most of the computational research will be done at the Jet Propulsion Laboratory/Caltech, although all the institutions will provide scientific expertise.

One way to discover the far-off planets (which are many light years away) is to detect the very faint light they give off. If we could see planets outside our solar system, they would glow because their atmospheres reflect the light from the star that they orbit, just like the Earth reflects the light of the Sun.



Planets can also glow because they are warm and give off their own heat. Humans can't see that heat, but special telescopes can.

This is a picture of an Earthrise as taken from the moon during an Apollo Mission. Notice the reflection of the Sun's light on the Earth.

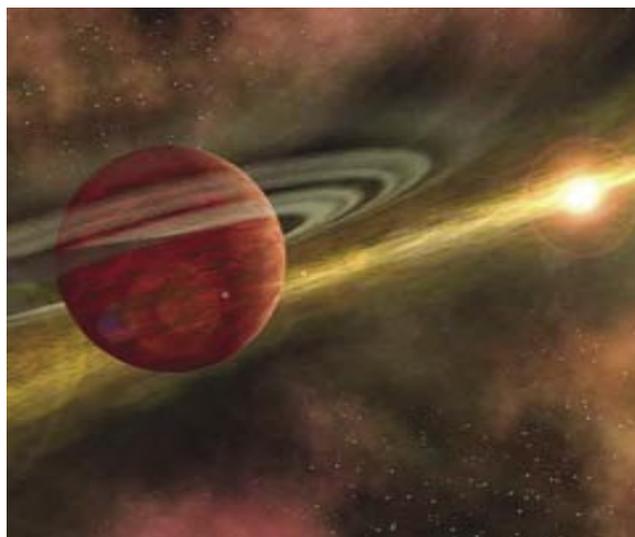


Spectrums of Familiar Elements

With information from telescopes, scientists can figure out the gases that make up the planet's atmosphere using a spectrometer. A spectrometer is a tool that breaks up the light given off by the planet into a spectrum. How does it work? When they interact with light, different types of atoms and molecules absorb and release certain wavelengths of light. These wavelengths show up as either dark or bright lines in very specific places. Every type of molecule or atom has a unique "fingerprint" of

lines that show up in certain places along the spectrum. By studying the fingerprint of lines in an atmosphere, the team can identify the different molecules that make up the gases, like water vapor, ozone, or methane, that are present in the planet's atmosphere.

Each virtual (computer-modeled) planet the VPL creates will have its own unique virtual atmosphere. Every virtual atmosphere will be broken up into its own unique spectrum. That way, scientists can compare the spectrum of a real planet to the spectrum of a virtual planet. If the atmospheres are the same, chances are good that the planets will be the same, too! This is because the gases in a planet's atmosphere are created by the planet itself. The VPL will model many different types of atmospheres. For example, life on Earth produces oxygen, so the Earth has oxygen in its atmosphere. Scientists looking for life on other planets might look for oxygen in their atmospheres. But, life on other planets might produce another type of gas, so the VPL will be able to simulate a wide range of different environments and types of life.



Artist Conception of a Planetary System Beyond Ours

Right now, scientists only know about one living planet—Earth. There might be other types of planets that can support life, and the key to figuring out what these might be like is to play around with the ingredients.

