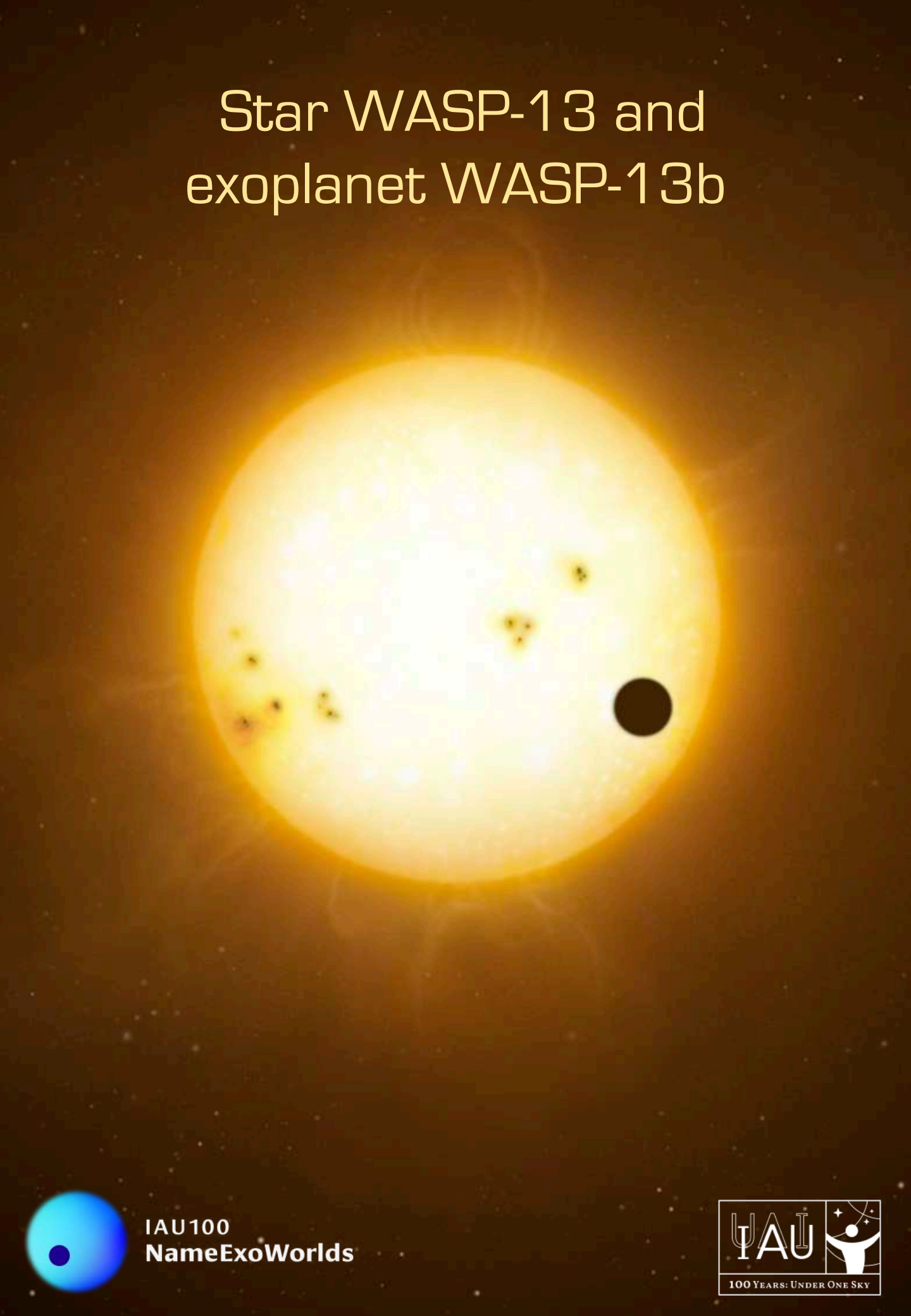
Star WASP-13 and exoplanet WASP-13b



IAU100
NameExoWorlds

IAU
100 Years: Under One Sky

United Kingdom International Astronomical Union Exoworld Naming Competition 2019

In celebration of its 100th anniversary, the International Astronomical Union (IAU) is giving budding young astronomers across the UK the opportunity to name their own exoplanet as well as the star around which the planet orbits.

Worldwide, the IAU ExoWorld Naming Competition has invited 93 countries to give a new name to different planetary system, consisting of an exoplanet – a planet that exists outside our own Solar System – and its host star. Each nation's star is visible from that country and is bright enough to be observed through small telescopes. Usually, the exoplanet itself is hidden by the brightness of the star and special observation techniques must be used to detect their presence.

The UK's designated exoplanet is currently named **WASP-13b**. It is a large, gaseous planet, about a third of the mass of Jupiter and it only takes just four days to orbit its host star, known as **WASP-13**. This star is very similar to our Sun, although it is likely to be slightly larger, hotter and older. The planetary system is over 740 light years from Earth, and is observed in the Lynx constellation.

To find out more information as well as how to enter the competition, please visit the UK Exoworld website at

www.exoworld.co.uk .

Credit: University of Keele/David A. Hardy

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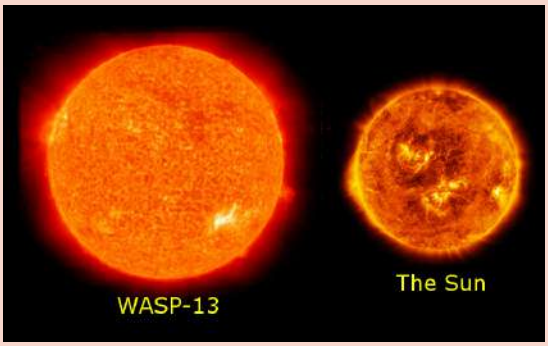
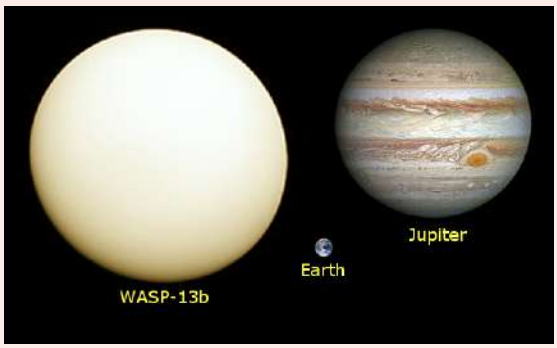
What we know about star WASP-13 and exoplanet WASP-13b

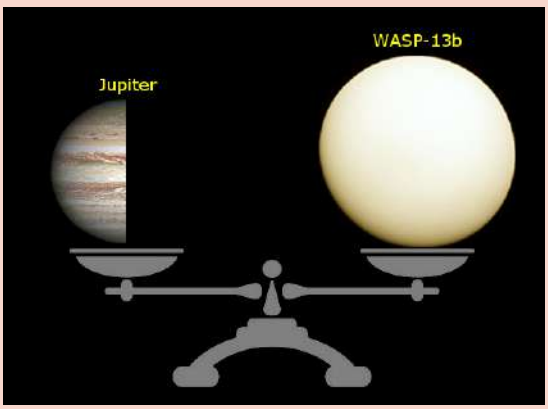
The star WASP-13 has a radius 1.5 times that of the Sun. Its mass and temperature, however, are very similar to the Sun. Its spectral type is G1, whereas the Sun is a G2 star. The fact that WASP-13's radius is so much bigger means that it is in the process of evolving into a Red Giant star.



The planet WASP-13b is 1.37 times the radius of Jupiter, the largest planet in our Solar System. It is thus a gas giant vastly bigger than Earth.

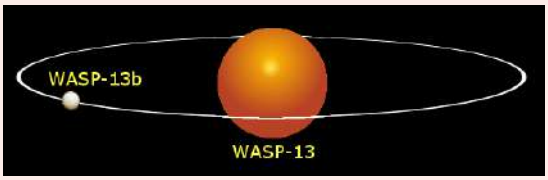


WASP-13b is only half the mass of Jupiter, which means that WASP-13b is much less dense. Like many hot-Jupiter planets it has a bloated radius caused by it being hotter than Jupiter on the inside.



WASP-13b orbits at a distance of 8.05 million km, taking 4.35 days to go round its orbit.

WASP-13b is in an aligned orbit. That means that it orbits above the equator of the star.



Information from the Wide Angle Search for Planets website run by the University of Keele.

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uclan University of Central Lancashire

WARWICK THE UNIVERSITY OF WARWICK

Primary school level activities

The following has been written in association with active research scientists to support work with primary-aged children. The activities are designed to complement the primary curriculum, while being enjoyable enough to be used as an activity at Rainbows, Brownies, Guides, Cubs, or other youth organisations. They are a selection of suggested activities that can be amended to suit the needs of your group.

They could be used as part of:

- Light, or Earth and Space science topics;
- science or STEM clubs;
- a STEAM (science, technology, engineering, arts and mathematics) or cross curricular activity;
- art and design KS1 or KS2 curriculum;
- a space badge at Brownies say;
- delivering the Democracy element of British Values;
- purely as a fun and enjoyable activity, exploring the universe around us!

We also recommend the ESERO primary school activities on exoplanets that can be found at www.stem.org.uk/rxera2 .

Mapping out a planetary system

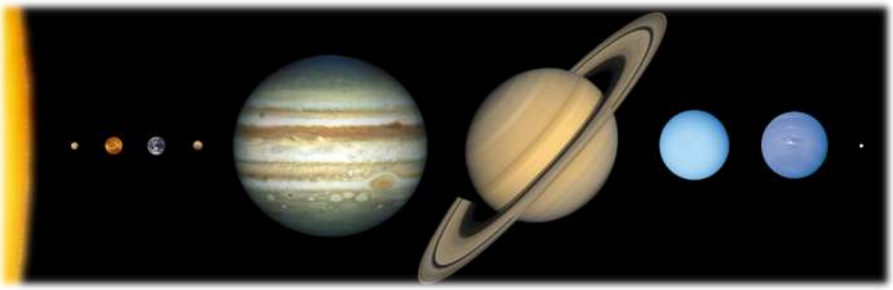
This activity helps participants grasp the sizes of stars and planets using every day objects. You could use the following resource from the Royal Observatory Greenwich;

- Fruit Solar System! www.stem.org.uk/rxyx3

If you want scale-up the solar system with your own objects, you could use a web resource such as

- www.exploratorium.edu/ronh/solar_system

This website allows you to choose a 'Sun', enter the diameter in mm and it calculates all of the distances and sizes of other planets for you. Tip: choose the biggest item for your Sun! You might like to include scaled planetary distances as well to show the vast areas of empty space across the solar system.



Now set up a scale model for **WASP-13** and **WASP-13b**. The star is around the same mass and only slightly larger than our Sun (1.3 times the Sun's radius).

However **WASP-13b** is one and a quarter the size of Jupiter and has an orbit 5% of the Earth's distance from the Sun. Discuss what it might be like on that planet. Is it hotter or colder than Earth? How bright would the star **WASP-13** be? What would it be like to live on a planet that orbits it's sun every four days?

You could produce a creative piece or art, poetry or writing describing this new planetary system, stimulating ideas for names to be submitted to the competition.

Sunlight/starlight pictures

Sun-sensitive paper is coated with light-reactive chemicals and can often be obtained from, for example, craft shops. It requires no chemical photographic equipment or darkroom facilities, just natural sunlight.

Simply place objects onto the surface of the sun-sensitive paper and leave exposed to the Sun. It is a fun and innovative way of making pictures while understanding the direct effect of sunlight.

You can create an investigation by asking questions such as how does the length of time that the object is exposed to the Sun affect the image? Is there a difference depending on the time of day?

Consider how the image you are creating might be different on a different planet such as **WASP-13b**. From what we know about this exoplanet, what difference would there be given that planet is so much closer to its star than we are to our Sun.

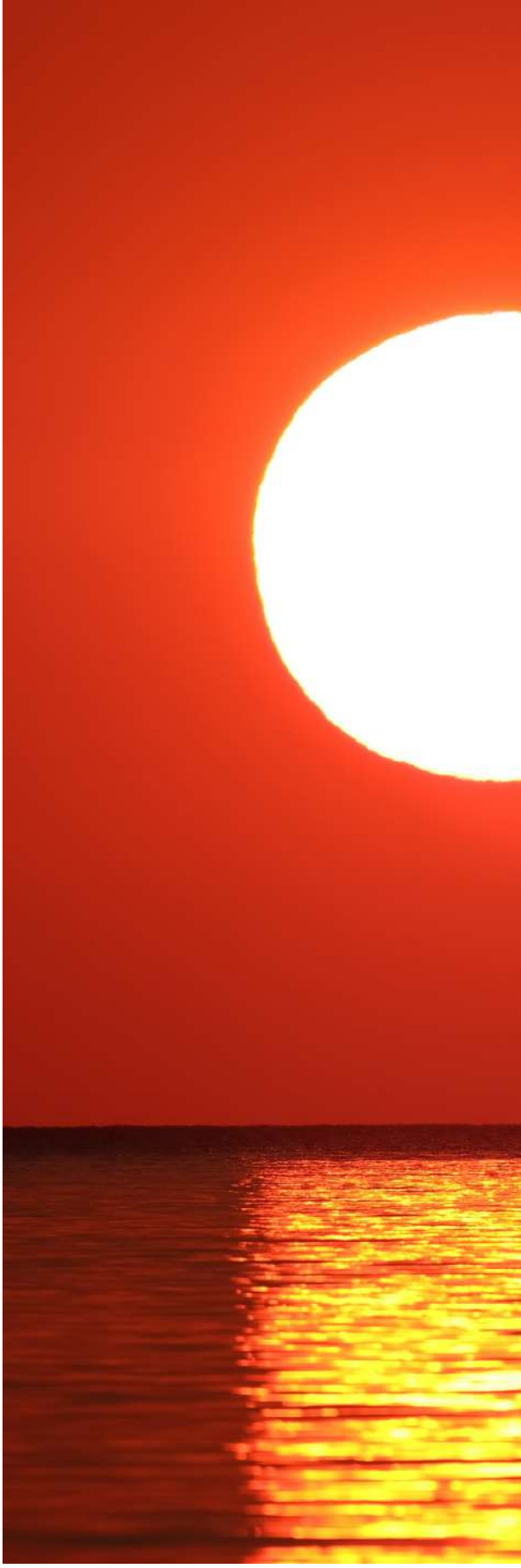


Photo by Francesco Ungaro on Unsplash

Photo by Artem Beliaikin on Unsplash

Exoworlds on a necklace

Shrink the planets down so that it can fit around your neck! Using the information at the following website;

- www.handmadecharlotte.com/make-a-stellar-solar-system-necklace

you can paint spherical beads to be like each of the planets in our solar system. If that's too messy, consider making them out of polymer clay.

Participants could explore more about each of the planets before making them, or for a collaborative activity split into groups who each make multiples of one particular planet.

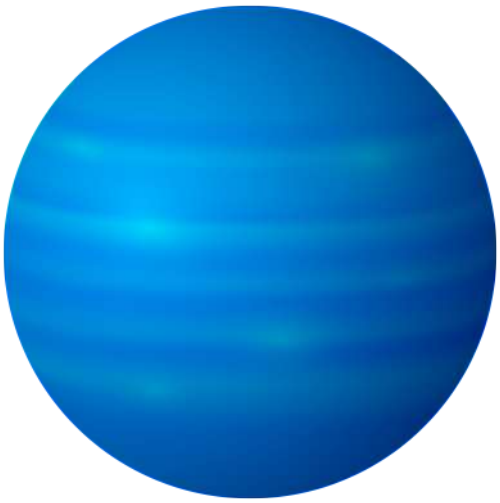
You could make a wristband to match with **WASP-13** and **WASP-13b** on. Who knew you could wear such cutting edge scientific discoveries! For older children, tiny black seed beads could be used to represent the distances between the planets.

Secondary school level activities

The following has been written in association with active research scientists to support work with secondary-aged children. The activities are designed to complement the aspects of the science curriculum, while being enjoyable enough to be used as an activity at other youth organisations. They are a selection of suggested activities that can be amended to suit the needs of your group.

We also recommend the ESERO secondary school activities on exoplanets that can be found at www.stem.org.uk/cx67v.

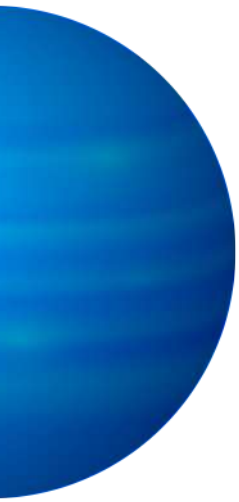
We would also encourage you to consider a more involved project on exoplanets using the "Extrasolar Planets Encyclopaedia Plotting Tool" with real exoplanetary data. This has been created by the National Schools Observatory and be found at www.schoolsobservatory.org/discover/projects/exoplanets/main .



Mapping out a planetary system

Set up a scale model of our solar system by spacing apart members of your class or youth organisation. A useful website with distances between each planet and the Sun is

- www.enchantedlearning.com/subjects/astronomy/planets



Different groups of students could use different scales – what scale would be used for drawing the solar system on paper, or for spacing people across a large hall or sports field? For differentiation, participants could be given the distances in Astronomical Units (AU) or in millions of km for an additional challenge to converting to appropriate scaled units.

Now set up a scale model of **WASP-13** and **WASP-13b**. The star is around the same mass and only slightly larger than our sun (1.3 times the sun's radius). **WASP-13b** has an estimated mass that is 0.477 times that of Jupiter and a radius that is 1.389 times Jupiter's radius. It orbits its host star at a distance of 0.05362 AU.

Consider what it might be like on **WASP-13b**. Is it hotter or colder than Earth? How bright would the star when viewed from the exoplanet? What would it live on a planet that orbits the its sun every four days?

Some answers can be deduced from the data and by comparisons with our own solar system. Some of these investigations could stimulate ideas for names for **WASP-13** and **WASP-13-b**. We would encourage you to be as creative as possible!

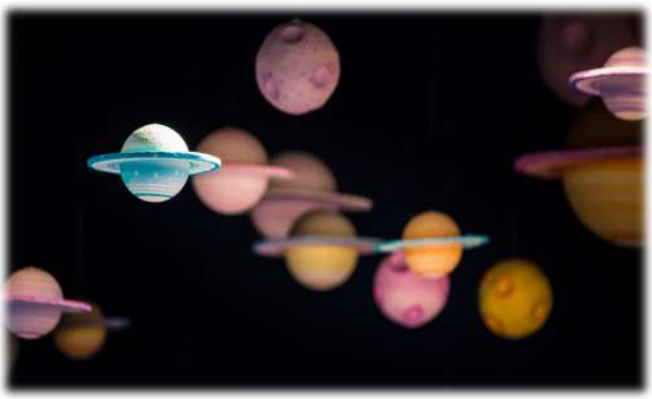


Photo by David Menidrey on Unsplash

Credit: ESO/L.Calcada

Orbital speed of planets and exoplanets

At what speed do planets revolve around their parent star? For our solar system, distances from the Sun (the orbital radius, R) and the time it takes to make one revolution (the orbital period, P) can be found here;

- www.enchantedlearning.com/subjects/astronomy/planets

The average orbital speed can be calculated using simply,

$$\text{speed} = \frac{\text{distance}}{\text{time}}$$

where the distance here is one complete orbit. If we assume that the orbit is a circle, this distance will be the circumference of that circle. So we have,

$$\text{Average orbital speed} = \frac{2 \pi R}{P} \quad .$$

Arrange the planets in order of speed in a "Fastest Planet Leaderboard". Was this what you expected? You might like to challenge some participants to present their findings using particular units, therefore requiring conversion between years, days etc.

Now predict where **WASP-13b** might appear in the order. It has a mass that is 0.477 times that of Jupiter and a radius that is 1.389 times Jupiter's radius. It orbits its star, **WASP-13** every 4.35298 days with a radius of 0.05362 AU. Where does this place the exoplanet on the leaderboard?

Exoplanet density

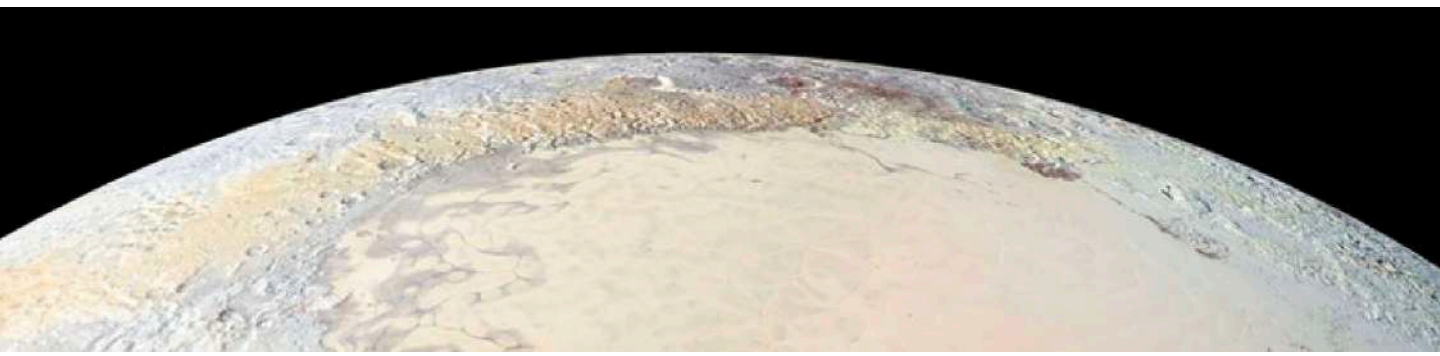
Use the STEM Learning worksheet found here: https://www.stem.org.uk/system/files/elibrary-resources/legacy_files_migrated/38124-planet_density_file_65612.pdf

In the "take it further" section, you could consider the density of **WASP-13b**. It has a mass 0.477 that of Jupiter (1.89813×10^{27} kg) and a radius 1.389 that of Jupiter (7.1492×10^{7} m). What is this in g/cm^3 and how does this compare to the planets in our solar system?

Gravitational field strength on WASP-13b

When exploring how weight of an object on a planet relates to gravitational field strength, g, it is possible to calculate g for exoplanets such as **WASP-13b** using the equation $g = GM/r^2$ where M is the mass of the planet, r is the radius and G the Gravitational Field constant.

WASP-13b has a mass 0.477 that of Jupiter (1.89813×10^{27} kg), a radius 1.389 that of Jupiter (7.1492×10^{7} m) and $G = 6.67 \times 10^{-11}$ $m^3 kg^{-1} s^{-2}$. How does this value of g compare to what we experience on Earth? Or on Jupiter? This is particularly useful for participants to understand that g relates to the mass of a planet, and not simply its size!



Choosing names for WASP-13 and WASP-13b

The naming rules for the UK IAU ExoWorld Competition can be found on pages 13 to 15 of this document as well as on the website. www.exoworld.co.uk. Please remember that the competition can only accept names for WASP-13 and WASP-13b that are submitted by **UK-based school classes and youth organisations/groups**. Each submission must be **undertaken by an adult** (18+ years) on behalf of the school class or youth organisations/group. Multiple separate submissions from a class/group are allowed. Unfortunately, **individual submissions outside of the above will not be accepted**.

To make a successful submission, you will need to provide to us with the following basic information:

- Name of school (class) or youth organisation (group) making the submission (for example; Year 5, W Primary School; Year 8 Science Class, X High School; Y Brownie Pack; Z Library Reading Group etc);
- County of school/organisation (these must be UK only);
- Name of school/organisation contact (who must be 18+ years old);
- Contact email address;
- Suggested name for star WASP-13;
- Suggested name for exoplanet WASP-13b;
- Naming theme – briefly outline why these names are being submitted.

We are looking for as much creativity as possible! Maybe individuals could think of names and present this to their class or youth group through an art competition or a debate or maybe even through drama or dance! A final set of names could be chosen by voting in some way, perhaps allowing proposers one minute to explain the reasons for their choice of name for WASP-13 and WASP-13b.

You could have the whole school or age groups put forward names by repeating the above in an assembly or gathering, with each class/group proposing and defending their names and then everyone voting for their favourites to be submitted.

Competition naming rules

It is very important that you understand the basic International Astronomical Union's Naming Rules for the IAU UK Exoworld Naming Competition. These are outlined as follows.

The competition will only accept names for WASP-13 and WASP-13b that are submitted by UK-based school classes and youth organisations/groups. Each submission must be undertaken by an adult (18+ years) on behalf of the school class or youth organisations/group. Multiple separate submissions from a class/group can be made.

Please note that unfortunately submissions by individuals will not be accepted.

The proposed names should be of things, people, or places of long-standing cultural, historical, or geographical significance, worthy of being memorialized through naming of a celestial object.

Although not necessary, it would be good if the names could be related to the UK in some manner. Also, the names may be drawn from themes related to the sky and astronomy or related in some way to the constellation that the exoplanetary system is observed within.

Two names should be proposed – one for the exoplanet and one for the star it orbits.

The two names should follow a common naming theme. The naming theme describes how the names are related in some logical way, should be summarized in a sentence or two, and be broad enough that additional names could be used to identify further objects in that exoplanetary system in the future (e.g. additional planets which might be discovered, additional stellar companions). Examples from the IAU include, say, rivers of country X or fictional lands in 19th century stories from country Y etc. but we are looking for as much creativity as possible!

Proposed names **must be**:

- between 4 and 16 characters in length in the Latin alphabet (including spaces or punctuation);
- pronounceable; and
- non-offensive.

If possible, names should preferably be one word and as mentioned, be connected to the United Kingdom in some manner.

In addition, proposed names **must not be**:

- names of a purely or principally commercial nature;
- names of individuals, places or events principally known for political, military or religious activities;
- names of individuals that died less than a century ago (after 1919);
- names of living individuals;
- names of organizations related to the selection process;
- names of pet animals;
- contrived names (i.e. new, invented);
- acronyms;
- names that include numbers or punctuation marks (though diacritics are acceptable; eg. déjà vu);
- names that are principally known as trademarks or protected by intellectual property claims.

We also reserve the right to exclude names that are too similar to those already existing names of astronomical objects. Names already assigned should be checked using the following links (the expert panel will also use these to guide the short-listing process):

- IAU names for asteroids in the Minor Planet Center database
- Names of galactic and extragalactic objects; Sesame name resolver
- IAU names for planets, dwarf planets, and satellites
- IAU names for stars
- IAU names for exoplanets

All proposed names **must be accompanied by a citation** of no more than 150 words explaining the naming theme for the names chosen.

The winning names will be recognized by the IAU as the appropriate **publicly used name for the object(s)**. It is understood that the selected winning names will not replace the scientific alphanumeric designations.

The winning names will be published as such, along with due credit to the proposers that proposed them. **This new name may then be used internationally along with, or instead of, the scientific designation, permanently and without restrictions**.

The official IAU rules are also available on the NameExoWorlds website.

Competition stages and schedule

Stage 1: Suggesting names (6th Sept to 18th Oct 2019)
Schools and youth organisations only will propose names for the UK's designated exoplanet and host star. A brief description and rationale for why those names have been chosen is required.

Stage 2: Choosing finalists (19th Oct 2019 to 15th Nov 2019)
The proposed names will be reduced to a small number of finalist names by a panel of experts.

Stage 3: A public vote (15th Nov 2019 to 29th Nov 2019)
Those school/youth organisations who proposed the finalist names will be notified. A public vote on the finalist names will be undertaken electronically via a form which will be available on the competition website.

Stage 4: The winning names are announced (mid-Dec 2019)
The winning names from the public vote will announced in mid-December 2019 along with all other winning names from countries participating in the IAU activity. The name of the school/class/youth organisation/group that proposed the winning names will be published and recognised internationally as the namers of WASP-13 and WASP-13b.

Visit www.exoworld.co.uk for all naming competition details.

Credit: ESA/C.Carreau

Partners

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uclan University of Central Lancashire

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Royal Astronomical Society 1820

Science & Technology Facilities Council
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