Winks Workshop

Student worksheet

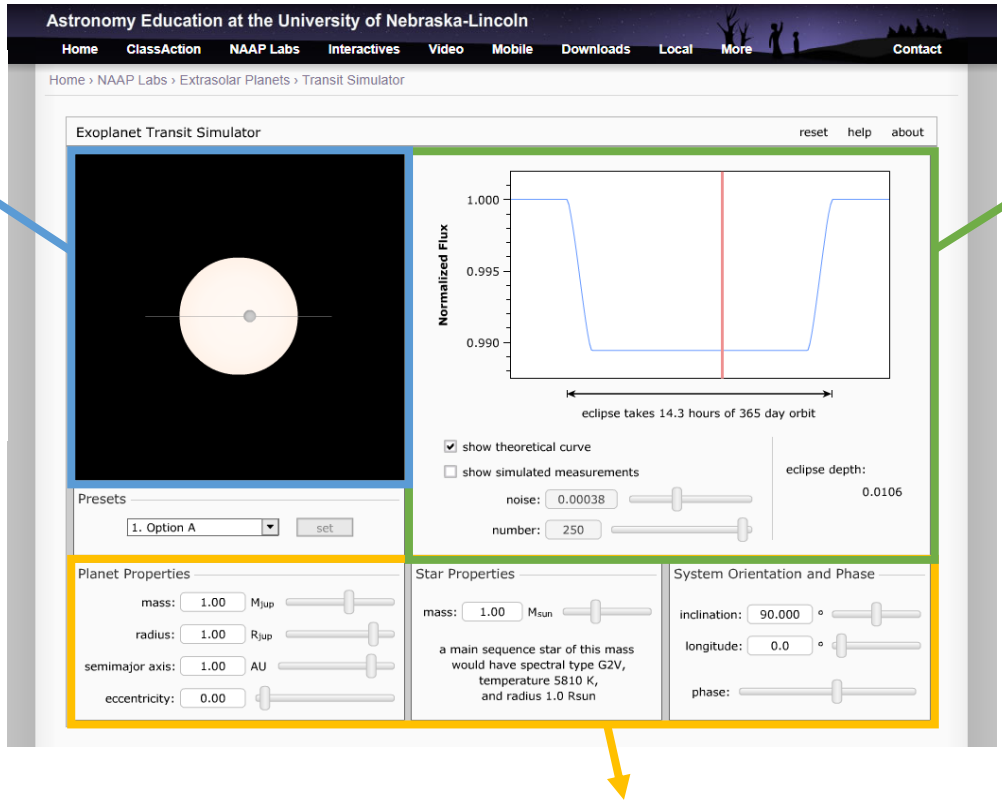
All of the resources and links needed for this workshop can be found at https://warwick.ac.uk/davidjabrown/transitworkshop

Part 1: Winks - exoplanet transits

Open the **Transit simulator** link (you will probably need to enable Flash to see the simulator).

You'll see something like this:

Visualisation of what the star's disc would look like from Earth if we had a powerful enough telescope. Planet and star are to scale with each other.



Transit light curve

You can toggle the theoretical curve and the measured data.

The red bar shows what's measured for the current setup in the visualisation panel.

Panels to control the system properties. Here you can change the mass of the star, the mass of the planet, the radius of the planet, how circular the orbit is, how far the orbit is tilted over, and how far apart the planet and star are.

Where it says "Presets", select 'Option A' from the drop-down list, and click 'set'. This shows a system that is basically Jupiter but in Earth's orbit around the Sun. Make sure that

- "Show theoretical curve" is selected
- "Show simulated measurements" is not selected

Now we're going to try adjusting the parameters to see how the transit light curve changes. After investigating the effect of each parameter, reset the simulator by clicking 'set' in the "Presets" panel.

*TR1: How does changing the **radius of the planet** affect the **depth** and **duration** of the transit?* _____

*TR2: How does changing the **semi-major axis** affect the **depth** and **duration** of the transit?*

*TR3: How does changing the **mass of the star** affect the **depth** and **duration** of the transit?*

*TR4: How does changing the **inclination** of the orbit affect the **depth** and **duration** of the transit?*

Now set the simulation to preset 'Option B'. This sets up a system like the Earth around the Sun. Also select "show simulated measurements", set the noise to 0.00008, and add the maximum number of measurements.

The PLATO space mission launches in 2026, and aims to detect planets like this system. It is predicted to have a measurement precision of 80 parts in 1,000,000 (a noise of 0.00008).

TR5: Do you think PLATO will be able to detect a single transit of this system? Explain your answer.

Part 3: Investigate - transit identification

Download and open the transit light curves spreadsheet.

Each tab of the spreadsheet contains data to create a different light curve.

Create graphs from each set of data that show the light curve.

IN1: Can you identify which light curve is caused by each of the following? Explain your choices.

a) *Earth-sized planet orbiting a star like the Sun, with an orbital period of 1 year.*
b) *Earth-sized planet orbiting a star like the Sun, with an orbital period of 5 days.*
c) *Earth-sized planet orbiting a star half the radius of the Sun, with an orbital period of 1 year.*
d) *Earth-sized planet orbiting a star half the radius of the Sun, with an orbital period of 5 days.*
e) *Jupiter-sized planet orbiting a star like the Sun, with an orbital period of 1 year.*
f) *Jupiter-sized planet orbiting a star like the Sun, with an orbital period of 5 days.*
g) *Jupiter-sized planet orbiting a star half the radius of the Sun, with an orbital period of 1 year.*
h) *Jupiter-sized planet orbiting a star half the radius of the Sun, with an orbital period of 5 days.*

As a hint, here's how the transit depth is worked out.

$$depth = \frac{Area_2}{Area_1} = \left(\frac{R_2}{R_1}\right)^2$$

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IN2: There are some light curves that aren't created by transits. What do you think could produce them?