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Activity: Pixel Count

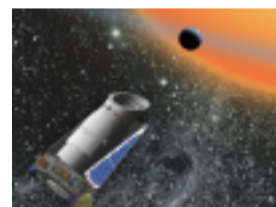


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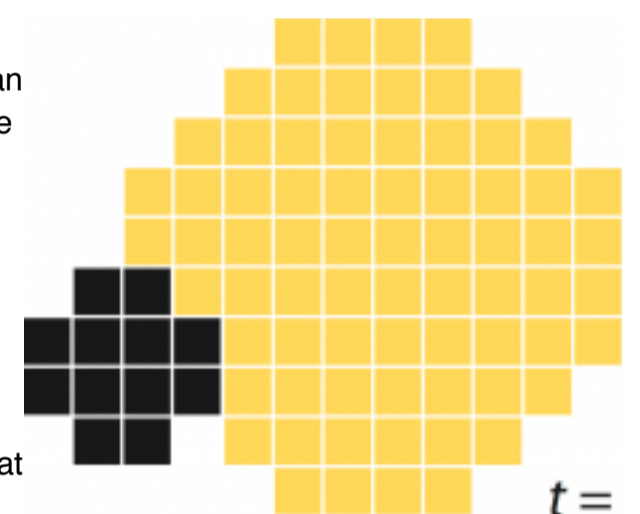
Chuck

Plot the amount of light detected by a spacecraft as it observes a planet transiting a star.

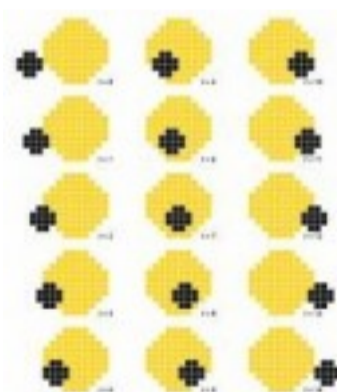
Background: There are several ways to find new planets. First, scientists can sometimes measure the wobble of the parent star caused by the gravity of the hidden offspring planet. Second, they can detect a Doppler shifting of the star's light spectrum as the orbiting planet repeatedly moves toward us, then away. Third, they can look for dips in brightness that reveal planets blocking out a little light as the planets orbit the star within our plane.



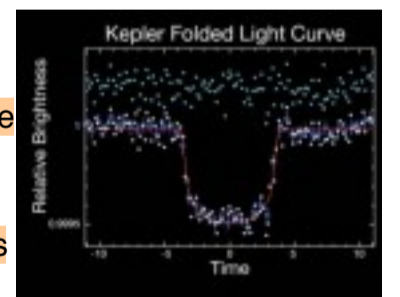
The **Kepler spacecraft** is monitoring over 150,000 stars simultaneously as it looks for planets around distant stars. For comparison, imagine looking down from a skyscraper at 150,000 streetlights that are miles away and you hope to see some gnats flying in front of a few lights. If the insect passes in front of the streetlight along your line of sight, the amount of light you see will dip by a minute amount. It may be too little for your eyes to notice, but the spacecraft is capable of discerning such small dips in brightness.



In this activity, the light from a star covers several pixels on a simulated computer chip. From afar, the star would appear as a mere point of light, but the closer you get the more you can see and count distinct pixels. For simplicity, students will count the number of pixels that reach the sensor for the duration of a transit. A recurring, periodic dip in brightness suggests a planet is orbiting the host star, whereas a random dip in brightness may indicate any object, such as a nearby asteroid in our own solar system, is intersecting the light path between the star and the spacecraft.

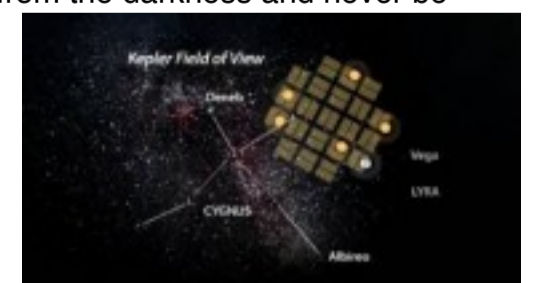


To Do: Print or display the **15 snapshots**, left, of a transit. On graph paper, plot the numbers of yellow squares (y-axis) per unit of time (x-axis). You may want to begin with multiple $t=0$ pixel counts to show the normal state of the scene with no transit, from which the curve can begin. The units of time are not defined for this activity, but a transit may last for several hours. Compare the graph derived by the students with actual data from a transit, right. To speed up the activity in a class, assign each kid the $t=0$ time frame just to make sure they are all on the same track. Then have the kids choose a partner to count the lone second snapshot you designate for them.



Note: In reality, the background should be black, not white. It is shown here in white to conserve ink when printing and to make the approaching planet's outline more apparent. The planet would emerge from the darkness and never be seen--it's dark side faces us. Also, do not confuse the pixels that comprise this one star with the Kepler's similarly shaped **field of view** (shown at right and in this **animation**), which is a broader area near the constellation Cygnus the Swan.

So far, the Kepler spacecraft has found hundreds of candidate systems of varying sizes, including a sun-like star with a planet in the habitable zone.



Supporting Links:

<http://kepler.nasa.gov/education/>
Kepler Education

<http://kepler.nasa.gov/multimedia/animations/scienceconcepts/?ImageID=97>
Animation of Field of View

<http://kepler.nasa.gov/multimedia/animations/?ImageID=38>
Animation of Plot From Transiting Star

<http://kepler.nasa.gov/multimedia/animations/scienceconcepts/?ImageID=136>

The Kepler Orrery of Planets

<http://kepler.nasa.gov/multimedia/animations/scienceconcepts/?ImageID=118>

How Many Planets Out There?

Adapted from Steven van Roode's *Transit of Venus-Classroom Activities*

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