**Storyline Activity #1:  Where and how do we find planets on the sky?**

**Purpose:**

            There are two goals for this activity - the first is to give everyone their first in-depth experience with many aspects of using the planetarium software, Starry Night.  The scientific goal is to see that the planets (and perhaps other Solar System objects, like Ceres & Eris) show a pattern in their location on the sky, which is that they are always along (or near) the Ecliptic, which runs through the Zodiac constellations.

**Objectives:**

            To investigate how Starry Night allows you to manipulate the sky (e.g., to look in different directions, add guides such as constellation stick figures, change the date, time, the time step, and others). Specifically, we want the group to focus on observing the locations of the planets and to discover that the planets are always found on or near the Ecliptic.

**Instructions:**

            Lead the group to follow along with Starry Night to do the following steps as a quick introduction:

1)  Using the N, E, S, W keys, they can turn to see the sky in various cardinal directions.  They will also grab the sky with the hand tool and move it that way.

2)  They will change the date and time to see how the sky is different over several different days and times.

3)  They will change the viewing location from the default to the location of their school and also to some random location in another country of their choice.

4)  They will turn on the constellation stick figures using both the radio buttons in the options pane, and then by just typing “k.”

5)  They will turn on the labels for Solar System objects using the options pane.

After this introduction, each group will be assigned a planet.  For advanced groups with knowledge of this topic already, they will be assigned a Kuiper Belt object -- Eris, Haumea, or Makemake, for example.

Their instructions will be to make a table that includes 10 rows with 10 different dates.  They are then to play around with the software until they find 10 dates on which their assigned planet is visible in the night sky.  They should strive to have widely separated dates, so 10 consecutive days should be discouraged.  When they find their planet in the sky on a date, they should record where it is in the sky (e.g., which cardinal direction, how high, etc.) to begin to think about how astronomers communicate position on the sky. They should also record which constellation the planet is found within.  The “find” tab can be introduced and used as a shortcut to finding a planet on any given date.  If a planet is not unambiguously associated with one constellation the “constellation boundaries” option can be turned on to help break the ambiguity.

**Assessment:**
After recording this information, groups should write a claim about where on the sky that planets are found and support it with evidence from Starry Night.  Groups will share out their results and discuss them.  The discussion should include:

1)  Is there any pattern to where the planets are found?  Is the pattern the same for all of the planets?

2)  Is there any pattern to the constellations in which the planets are found?  Is the pattern the same for all of the planets?

3)  Given the identified pattern (which should be that the planets seem to lie along a line or great circle on the sky), can the group propose how the planets are distributed in 3D to give rise to this pattern?

During this discussion, it is likely that a question will naturally arise about describing locations on the sky using astronomical coordinates (mostly altitude and azimuth, but potentially right ascension and declination), the location on the sky of the meridian and the Ecliptic, and the meaning of the Ecliptic.  Since the Ecliptic is defined as the plane of Earth’s orbit around the Sun, you want the students to arrive at this conclusion from their data.  If the Starry Night exercise is not enough to reach this conclusion, the activity “Sky Time”, which is also called “Kinesthetic Astronomy” is a good supplement.

Lastly, the group should then return to Starry Night and turn on the Ecliptic in the options pane. Then they should input a few of their dates from their data table, and note how close to the Ecliptic their planet is on most nights.