

## Experiments

Believe it or not, there are a surprising number of fun little experiments you can do with Grand Tour to more easily visualize the rhythmic cycles of our spot in the galaxy.

### Watch the Earth

Place your eyepoint above the eastern side of the Earth, turn off the tethering option in the preferences, then let your iPhone or iPod sit for some time. Soon you will notice that the Earth is growing smaller and smaller as it moves away from you. In effect you have fixed yourself in space, and are watching your home planet leave you behind in its wake. And all in real time! Look a little closer and you should see that it has rotated as well turning the entire world into a giant clock.

Also you will notice the clouds slowly shifting every few hours as new cloud data becomes available (if you are connected to the net). Not fast, but fascinating nonetheless.

### Watch the Moon

Place your eyepoint above the moon, and accelerate the time. You will see it slowly move about the Earth, but always keeping the same face locked towards our planet. When the moon is full it will be directly opposite the sun, and its backside in complete shadow. When new, it will be in between the sun, and us, with its face in shadow

What is happening is that the denser part of the world over eons, eventually ends up aiming towards its parent planet. Do this with the other moons and you will see that with few exceptions, they all do the same.

### Spin around Saturn

Now jump out to Saturn. Hover over the northern part, back off a little (by double tapping the lower half of the screen) and speed up the time. Now observe how its menagerie of little moons scurry about their unending orbits. Move to Mimas, untether your eyepoint and scroll around until Saturn is in the background. Now speed up time, and just watch how quickly little Mimas darts away to the other side of the ringed world. (That doesn't demonstrate much, it's just cool to look at).

You may want to head on out to Phoebe, the furthest known moon from Saturn. Thought to be a captured asteroid, look back at Saturn from Phoebe, a staggering 8 million miles distant. In fact Phoebe is so far away from the planet, its "month" is equal to about  $1 \frac{1}{2}$  of our years Also with its highly inclined orbit, it

is one of the very few moons that can actually see the rings of Saturn. Most of the rest can only see them edge on, hence rendering them a mere slice of a line across the inky black skies.

And for a really cool looking vista, turn off tethering, go to Mimas, one of the closest of Saturn's larger moons, and hit fast-forward. Sit back and watch for a couple of minutes. Pretty cool, eh?

### **Jog over to Jupiter**

Another really pretty scene is to fly to the sulfurous orange moon, Io. Sometimes called the Cosmic Pizza, its colors are dramatic in the usual monotone world of space. Tether your eyepoint and roll the moon around until Jupiter comes into view behind it. Now speed up the clock and watch how the gas giant lumbers slowly behind the pizza. If you're lucky you might see some of the other Jovian moons popping in and out.

### **What did Galileo see?**

One of Galileo's earliest and most important discoveries was what he first thought were little stars near Jupiter. Over the evenings he noticed that the stars appeared to move *around* Jupiter. This led him to conclude that the earth was likely not the center of the solar system, but moving around the sun as Jupiter's "stars" moved around it. While Jupiter has several dozen known moons, the four brightest are called the Galilean Moons.

You can see roughly what Galileo saw. Move out to Jupiter and rotate it so it is full (i.e. not in a crescent phase). Now double-tap the bottom part of the screen four or five times to back your eyepoint away, so all of Jupiter's moons come into view. Open the clock's toolbar and hit the fast-forward button several times and you will see Galileo's four moons in action. Would you reach the same conclusion that he did?

Incidentally, these moons are bright enough to be visible through even a modest pair of binoculars although there are some reports of people seeing at least one of the moons with their naked eyes.