



## History and Discovery of Asteroids

## Vegetable Light Curves

### ASSEMBLY INSTRUCTIONS

1. The following materials and equipment are needed for each team:
  - **Two potatoes.** One potato should be spherical and the other should be elongated. If you use potatoes that are very elongated—you'll get better results. A long sweet potato of nearly uniform diameter would work well. A cucumber might be substituted for the second potato if it is more convenient to do so. A long carrot of more or less uniform diameter may also be used for making additional observations.
  - **An illumination system.** Ideally this will consist of a dark background against which the potatoes can be viewed, and a 40-watt lamp and shield that directs light primarily in one direction. Alternatively, the activity may be carried out in a dark room.
  - **Parts for potato rotation system.** Obtain the following items for each system, as shown in the photograph below: 1) a small electric motor with a ¼-inch drive shaft to provide a means of rotating the potatoes at a constant, slow rate. A heavy-duty motor that revolves at a steady 3 rpm is sold by Scientifics at a nominal price that works exceedingly well for this activity. The directions that follow utilize this motor. The motor has a hole in the shaft and a flange that permits it to be attached to plywood or another base with screws if it is so desired; 2) a 2- to 3-inch piece of electrical or other tape that is about ¾-inches wide; 3) a small hose clamp; 4) a ¾-inch long paper clip that has been cut with wire cutters to provide a loop 3¼ inches long; and 5) a small screwdriver.

To order a motor, contact Scientifics.  
Web address: [www.scientificsonline.com](http://www.scientificsonline.com)  
Phone orders: 1-800-728-6999  
Address: 60 Pearce Ave.  
Tonawanda, NY 14150-6711  
Item number: F30607-44  
Cost: \$15.95



2. **Assemble the potato rotation system as follows:** Insert the loop of the cut paper clip into the hole in the motor's shaft so that the cut ends are pointing upward. Hold it in place while you tightly wrap it with the tape. Next, place the hose clamp over the tape and tighten it securely with a screwdriver. The potatoes can be pushed down on the upward-pointing ends of the cut paper clip to mount them securely to the motor and shaft. In the photograph below, you can see a picture of a potato mounted in this fashion. In the following sections, these upward-pointing paper clip segments will be referred to as "mounting pins."



3. **Procedures:** First, choose the spherical potato. Gently push it down on the mounting pins so it will be securely held in place while the motor rotates the potato in front of the observer. The mounting pins should be inserted into the approximate center of gravity of the potato so it does not wobble during rotation. You may want to determine the center of gravity ahead of time and mark it with a pen. With the motor running, make the required observations.

A similar procedure is followed with the elongated potato mounted in a horizontal orientation. This potato should be mounted in such a way that the mounting pins are stuck into the potato half-way between the two ends very near the center of gravity. You may want to find the approximate center of gravity by determining the point where the potato can be more or less balanced on the eraser of a pencil or other blunt object. Once again, you do not want the potato to wobble. With the motor running, make the required observations.

Similar procedures are followed for mounting the long potato in a vertical position and making the required observations. Once again, do this with care, since you do not want the potato to wobble.

If you extend the activity to include a carrot, be very careful so that you do not bend the mounting pins. It may be advantageous to "drill" small holes in the carrot with an opened paper clip to match the mounting pins before the carrot is placed on the apparatus. This should be done carefully to avoid getting injured should the paper clip slip.

### **Alternative Rotation Devices**

Other rotation devices might be designed. For example you might use a faster motor and couple it with a gearbox (also available from Scientifics) to provide an acceptable lower rotational speed. Rotation speeds faster than approximately 3 rpm are not desirable. A motor/gear box combination for reducing the rotation speed of a faster motor might be used in conjunction with a discussion of machines such as levers and gears. A motor that does not have a hole in the shaft will require a different mounting system. If motors are not available, you might use a woodworker's hand drill to hold a sharpened dowel stick (hazardous, be careful) upon which the potato is mounted and then ask a team member or other individual to turn the drill at as close to a constant, but low, speed as possible. Finally, if none of the above is feasible, have a team member or other individual rotate the dowel stick by hand at a slow and constant rate. The potato should be rotated at a speed such that observers are able to see clearly how the surface area changes as the potato rotates. If these latter two methods are used the quantitative extensions will not be feasible.