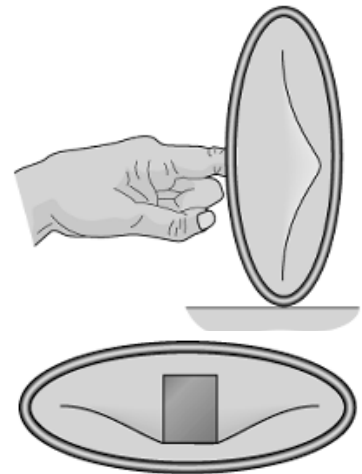


### Activity 3-2: A Mechanism for Normal Forces

*Students have already developed a quantitative understanding and description of the gravitational force, and have just discussed the need for a Normal force. The normal force is a force exerted by a table or floor that balances that of gravity so that objects don't fall through. This activity will help reinforce acceptance of a force that we rarely think about and develop an idea of how it can "know" to provide just enough force to balance gravity or a push.*

By applying forces perpendicular to flexible surfaces with different degrees of stiffness, you can discover a mechanism for the passive normal forces that crop up in reaction to forces applied to a surface.

1. Hold the embroidery hoop with the stretchy cloth vertical and press in the center perpendicular to the cloth surface. Observe what happens to the center.
2. Press harder in the center of the elastic surface and again observe what happens to the center.
3. Repeat steps 1 and 2 using the stiffer (less flexible) hoop. Try to apply pushes of about the same magnitude as in steps 1 and 2, and observe how much the surface is displaced and how hard the surface pushes back on your finger.
4. Do a similar set of investigations using the same hoops held horizontally with 50-g, then 100-g, and finally 150-g masses placed at the centers of the surfaces.



**Question 3-4:** When the elastic surface has a force applied to its center, does it push back? How do you know? Does the force seem to change as it is pushed harder?

**Question 3-5:** What happens to the center of the elastic surface when it is pushed? What happens as it is pushed harder?

**Question 3-6:** Did the surface of the stiffer material bend more or less than the more flexible elastic surface when the same force was applied? Explain.

**Question 3-7:** What mechanism do you think might explain the ability of the surfaces to react to an active force by applying a normal force?

**Question 3-8:** Based on your observations with the stiffer surface, what would happen to the bending of the surface if it was made up of hundreds of layers of cloth to resist a person's push or hold up a mass?

**Question 3-9:** Does a table or wall bend *noticeably* if an active force is applied to it? What mechanism do you propose to explain how walls and tables can exert normal forces? Do you think that the surface bends at all? Explain.

