**Student Worksheet: Hula-hooping robots**

**Directions**: Read the online *Science News Explores* article “[Wiggling robots reveal the physics of how Hula-Hoops stay up](https://www.snexplores.org/article/hula-hoop-physics-wiggling-robots).” Then answer the following questions as directed by your teacher.

**Before Reading**1. Have you ever used a Hula-Hoop? If so, how long were you able to keep it moving about your waist before it fell? Do you remember any techniques or strategies you used?

2. To the best of your understanding, describe the forces that keep a Hula-Hoop from falling. Support your explanation by drawing a picture. Use arrows to illustrate the direction of different forces that might come into play when using a Hula-Hoop. Optional extension: Name the forces that you used in your illustration.

**During Reading**1. Explain how an hourglass shape helped robots keep Hula-Hoops up.

2. What inspired Leif Ristroph to investigate the physics of Hula-Hoops?

3. What does it mean for an object to gyrate?

4. Describe two robot shapes Ristroph and his team tested besides the hourglass.

5. Pick one of the non-hourglass-shaped robots and describe the problem encountered when it tried to keep a Hula-Hoop in place.

6. Explain how the robot's shape contributed to the problem described above by comparing it to the performance of the hourglass-shaped robot.

7. Which of the tested shapes managed to keep a Hula-Hoop up after adjustments? Describe what adjustments were made.

8. Imagine you’re teaching a friend how to hula-hoop. Write step-by-step guidelines, including tips from the article on how to keep the Hula-Hoop aloft.

**After Reading**
1. Imagine swinging a donut around your finger like a Hula-Hoop. As the donut swings, imagine the donut hole gets wider. You adjust your finger's gyrations, thus managing to maintain a constant donut-spin speed. Predict how you changed your finger's gyrations to successfully preserve the donut's spin speed. Explain how you came to your answer by pointing to information in this story.

2. Imagine a ball-shaped robot and a bottle-shaped robot trying to hula-hoop. Do you think a ball-shaped robot will manage to keep the Hula-Hoop up? What about the bottle-shaped one? For each robot, explain why you predict success — or not. Point to findings from this story to support your prediction.