



# NUTCRACKER

## Choreography Challenge

### OVERVIEW

Ballet dancers are affected by many forces when they are dancing. The goal of this lesson is to explore some of the ways dancers try to increase and decrease these forces.

### DIRECTIONS

1. Watch a video of a ballet dancer demonstrating different turns and spins. What do you notice about how fast they are spinning? Does their speed change as they move their arms or legs? How do you think they could spin faster?
2. Begin by having youth practice trying to spin, or pirouette, the way the dancers did. Make sure youth are in a safe space where they won't bump into anything. Ask them to think about the position of their arms and legs during these movements. Were you able to spin fast? What things did you change to try and spin faster? Keep track of the different things tried and the speed of the spins. You can use words like slow, slower, faster or fastest. Recording trials and making measurements are characteristics of a good experiment.
3. Try repeating the same trials while youth are sitting in a spinning chair. Make sure there is adult supervision. Again, have youth think about the position of their arms and legs during these movements. Caution: spinning too fast can make you dizzy and feel unstable. If they begin to feel dizzy, have them sit or lie down until the feeling stops. Dancers are subject to feeling dizzy when they spin. Go back and watch the video again and look at how the dancer holds his/her head when spinning. This is called "spotting." You can try this technique during your spinning trials to see if it helps with not feeling dizzy.
4. If you have a PocketLab, attach it with tape or self-adhering bandage wrap to a part of a youth's arm or leg. You can select any of the following measurements:
  - Acceleration = change in speed
  - Angular Velocity = how fast it moves around a center point
  - Velocity = the rate of change in distance
5. Repeat the experiment of spinning on their feet as well as in the chair. How do you think the graph will change for each of the

**Grades: 3-12**

### MATERIALS

- Spinning Chair
- Paper
- Pencils
- PocketLab Voyager\*
- Tablet or computer\*
- Tape or self-adhering bandage wrap\*

### PARTNERS



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measurements as you spin? What happens to the graph as you move your arm or leg while spinning? What situation and body position gives you the greatest angular velocity?

## REFLECT AND APPLY

1. Ballet dancers are constantly using and combatting gravity and friction. Gravity is the force that pulls on things based on their mass. Friction is a force created when objects move past each other.
  - How do you think gravity is helpful to dancers? What would happen if there wasn't gravity?
  - How do you think friction is helpful to dancers? What would happen if there wasn't friction?
  - How do dancers try to reduce friction? How did you try to reduce friction during your experiments? What else could you have done to reduce friction?
2. Centripetal force is the force that keeps you moving in a circular motion. Youth can feel this force when they spin. The velocity of a spinning object is related to the distance from the center of the circular motion. The shorter the distance the greater the velocity. This can be felt while spinning as well as seen in the PocketLab graph.
  - When spinning, why do dancers start with their arms out and then move them closer to their body?
  - How could a dancer create more angular velocity in their spin?

## NUTCRACKER MAKER

### Art Challenge

Now that you know more about spinning or pirouettes, create a simple piece of choreography to a section of the Nutcracker Ballet's music or other music of your choice. Choreography is a sequence of steps or movements done to music in dance. We encourage you to include at least one pirouette if possible. Consider showing your choreography to an audience too! Consider making a light up holiday card or a light up set piece. One idea would be to use the light up set pieces in a reader's theater performance of the Nutcracker. The cards could be given as invitations to this performance!

## CAREER CONNECTIONS

**Auto mechanics** work on many spinning components of vehicles (wheels, crankshaft). They work to ensure that these components can freely spin and transfer motion. Oils, grease, bearings and even magnets can help car parts move smoother by reducing friction.

**Lab technicians** use many pieces of equipment in order to study different materials and tissues. Centrifuges are able to separate materials based on their weight by spinning them very fast. It causes the heavier materials to move to the bottom and lighter materials to move to the top.

**Dancers** work with forces and motion for balance, jumping, spinning and moving. They must understand how their body's position not only affects but can be affected by different forces.

