

# How Does a Yo-Yo Work?

By Sharon Fabian

<sup>1</sup> Somehow the words *yo-yo* and *physics* just don't seem to go together, but they do. Because if you want to know how a yo-yo works, the answer, in a word, is physics. The explanation for what makes a yo-yo go up and down, sleep, and do tricks is all based on concepts from physics. These concepts include kinetic energy, potential energy, and momentum.

<sup>2</sup> There have been several kinds of yo-yos through the years. Each new kind of yo-yo used more ideas from physics to make it work better. Old style yo-yos had their strings tied securely to their axles. Newer yo-yos had their strings looped loosely around their axles. Even newer, automatic yo-yos have a built in mechanism that make them come back up automatically.

<sup>3</sup> Once you wind up the string of a yo-yo, any kind of yo-yo, and hold it in your hand, it has potential energy. In fact, it has not one, but two kinds of potential energy. It has potential energy because it can drop down, and it also has potential energy because it can unwind. When you let go of the yo-yo, gravity pulls it down. It is also forced to rotate because the string is fastened to your finger and also wound around the yo-yo's axle. As it drops, the yo-yo's potential energy changes to kinetic energy, the energy of motion.

<sup>4</sup> One other thing happens while the yo-yo is dropping. It builds up momentum. Just as it has two kinds of energy, the yo-yo also builds up two kinds of momentum. It builds linear momentum, which is the momentum to keep going straight up and down, and it also builds angular momentum, which is the momentum to keep rotating.

<sup>5</sup> Going up and down, a yo-yo continually cycles between having potential energy and having kinetic energy.

<sup>6</sup> Of course, a yo-yo will eventually stop, and that is because friction slows it down a little bit more on each trip up and down its string.

<sup>7</sup> Newer yo-yos, with the string looped loosely around the axle, have less friction. Also, since they are not tied tightly, they are not forced to roll back up once they hit the end of their string. That is why newer yo-yos can "sleep," which means that they keep spinning on the end of their string. They can even be made to roll along the floor at the end of their string like a dog on a leash. That is the yo-yo trick known as "walk the dog."

<sup>8</sup> The newest yo-yos called automatic yo-yos have a built in clutch. The clutch releases the yo-yo's axle when the yo-yo is spinning quickly and then grips it when the spinning slows down. This makes the yo-yo roll back up automatically.

<sup>9</sup> There are other innovations that help yo-yos to perform more smoothly, too. Some yo-yos are made with most of the weight on the outside rims. This helps to keep them balanced longer. These yo-yos can sleep for a longer time so they can be used to do more tricks. Some yo-yos are even designed with ball bearings around the axle to reduce friction and give higher performance.

<sup>10</sup> In addition to the physics, there is one more thing that makes a yo-yo perform well and that is the operator. Just like with driving a car, operating a yo-yo takes practice. Practice, practice, practice, and one day you will be able to do tricks like "walk the dog" and "rock the baby." A little more practice and you might be ready to do "double or nothing" or "pop the clutch."



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<p>1. The explanation of how a yo-yo works depends on the science of _____.</p> <p><input type="radio"/> <b>A</b> Geology</p> <p><input type="radio"/> <b>B</b> Physics</p> <p><input type="radio"/> <b>C</b> Chemistry</p> <p><input type="radio"/> <b>D</b> Biology</p>	<p>2. The energy of motion is called _____ energy.</p> <p><input type="radio"/> <b>A</b> Potential</p> <p><input type="radio"/> <b>B</b> Momentum</p> <p><input type="radio"/> <b>C</b> Kinetic</p> <p><input type="radio"/> <b>D</b> Physical</p>
<p>3. _____ yo-yos had strings tied tightly to their axles.</p> <p><input type="radio"/> <b>A</b> Older</p> <p><input type="radio"/> <b>B</b> Newer</p> <p><input type="radio"/> <b>C</b> Automatic</p> <p><input type="radio"/> <b>D</b> All of the above</p>	<p>4. As a yo-yo rolls down its string, it builds up _____.</p> <p><input type="radio"/> <b>A</b> Friction</p> <p><input type="radio"/> <b>B</b> Momentum</p> <p><input type="radio"/> <b>C</b> Weight</p> <p><input type="radio"/> <b>D</b> Potential energy</p>
<p>5. Yo-yos eventually stop because of _____.</p> <p><input type="radio"/> <b>A</b> Weight</p> <p><input type="radio"/> <b>B</b> Their strings being too short</p> <p><input type="radio"/> <b>C</b> Friction</p> <p><input type="radio"/> <b>D</b> Their strings being too long</p>	<p>6. When talking about a yo-yo, "sleep" means _____.</p> <p><input type="radio"/> <b>A</b> Roll along the floor</p> <p><input type="radio"/> <b>B</b> Rest in a person's hand</p> <p><input type="radio"/> <b>C</b> Spin at the end of its string</p> <p><input type="radio"/> <b>D</b> Stop spinning</p>
<p>7. Name two or more yo-yo tricks.</p> <p>_____</p> <p>_____</p>	<p>8. Of the three types of yo-yos described in this article, which could probably do the most tricks.</p> <p>_____</p> <p>_____</p>

## How Does a Yo-Yo Work? - Answer Key

- 1 **B** Physics
- 2 **C** Kinetic
- 3 **A** Older
- 4 **B** Momentum
- 5 **C** Friction
- 6 **C** Spin at the end of its string
- 7 Answers may include walk the dog, rock the baby, pop the clutch, double or nothing, or other yo-yo tricks that the students know about.
- 8 The automatic yo-yo