

MIDDLE SCHOOL DISCUSSION GUIDE

HOW TO BECOME AN ARCHERY SUPERHERO



GRADE LEVELS

Middle School - Grades 6-8

ENDURING KNOWLEDGE

Students will know the basic physics of how various types of bows used in archery convert stored potential energy into kinetic energy. They will also know how different types of bows store different amounts of potential energy because of their design as they relate to the different force/draw curves.



LEARNING TARGETS: After viewing the video, students will be able to:

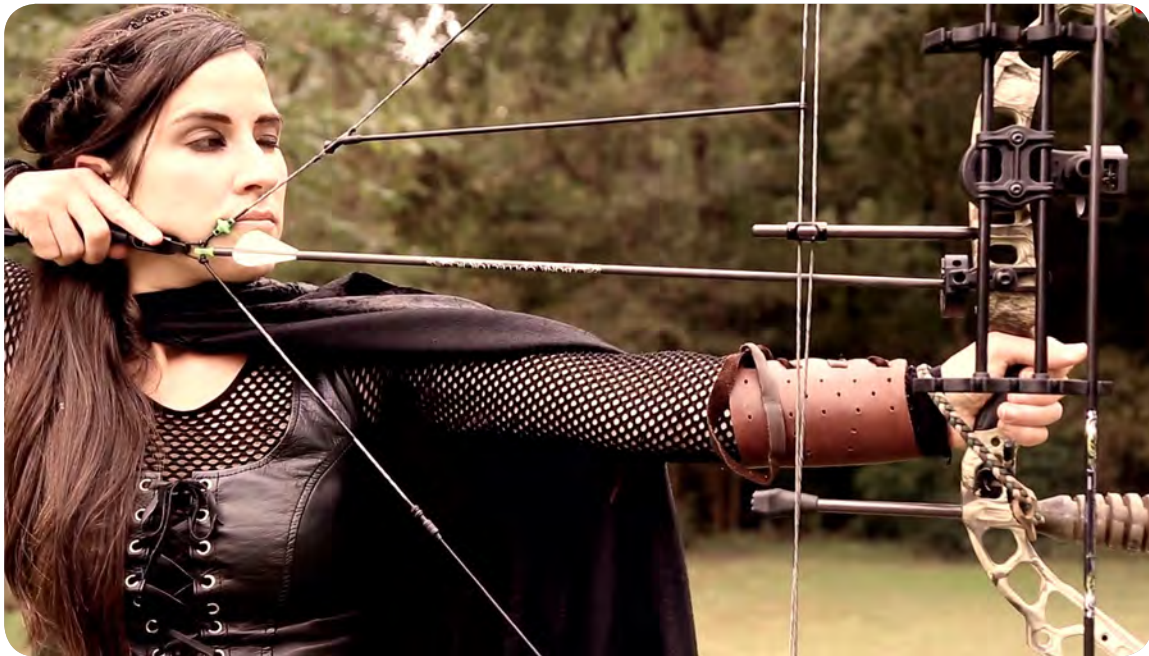
1. Summarize the three main types of bows used in archery.
2. Give examples of how fictitious archery superheroes might use different bows and how different bows are actually used in modern archery.
3. Describe how a person can physically store potential energy in a bow.
4. Explain how stored potential energy in a bow is converted into arrow velocity.
5. Tell what kinds of bows are used in the Olympics.
6. Explain why superheroes would use different bows in different archery scenarios.
7. Describe the different accessories used to shoot bows and arrows.



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DISCUSSION GUIDE FOR THE VIDEO



TEACHER BACKGROUND

Archery “Superheroes” are the rage in Hollywood, action computer games and comic books. The image of a superhero fighting the forces of evil with whistling arrows evokes a sense of power and nobility that is likely tied to the history of the bow and arrow.

The first bows invented around 20,000 years ago weren’t much more than flat sticks bowed by a string that later became refined into elegant European yew longbows or Mongolian recurves made from composite animal horn and sinew. The Dark Ages saw the adaptation of bows into short horizontal crossbows that proved no match for the repeated shooting speed and accuracy of the longbow – one reason England dominated so many European Medieval battles during those times.

In North America, Native people were the first to use bows for hunting and warfare. And it was one Indian in particular in the early 1900’s who helped spread the romance and allure of hunting with homemade bows and arrows to two white men in California. The Yahi Indian’s name was Ishi, and the two white Americans were Saxton Pope and Arthur Young. Pope and Young soon infused a fledgling nation with the romance of archery and the rest is America archery history.

The homemade longbows of Pope, Young, and some of the other pioneers in American archery eventually gave way to the laminated recurve bow, with limbs that both unfolded and bent back during the draw. This limb design increased the conversion of stored energy when the bow was shot. A big change in bow design began in the late 1960’s and early 1970’s with the invention and refinement of the compound bow.



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TEACHER BACKGROUND *(continued)*

Today's Bows

The end result of bow evolution is that today we have three types of commercially produced bows commonly used in archery and bowhunting that blend both the past and the present.

1. **The longbow** is made of laminated wood and fiberglass with varying limb shapes from straight to slightly curved.
2. **The recurve bow** is made from laminated wood and fiberglass with pronounced "recurved" limbs.
3. **The compound bow** is made from a variety of substances that employs the mechanics of cams and cables to alter the energy conversion of the short limb's stored energy.

Archery Note: All three types of bows have also been adapted into crossbows with shorter horizontal versions equipped with a gun-style stock and trigger mechanism.

Which bow is best?

Today's super heroes in the movies equip themselves for their adventures using one of these three styles of bows. So how does Hollywood or the superhero choose which bow is right for their super adventure? Each bow has its own combination of advantages and limitations. That's a function of their design and the physics of how they shoot an arrow, as they relate to our human anatomy. And understanding all that is the key to understanding why a superhero would select a certain type of bow to use in different types of archery.

The differences in how these three types of bows store and release energy in shooting an arrow present interesting series of questions for us to explore and answer in our quest to understand "which bow is best".

The physics of archery

A bow is essentially a two-armed spring that stores mechanical "potential energy" when the string is drawn and pulls back the limbs. Here's how the different parts work.

When you draw back the bowstring, you use your muscles to exert a force on the string that bends the limbs backward. The amount of force that your fingers exert on the string when you've pulled it all the way back is called the "draw weight." The elastic or spring energy is now "potential energy" that can be converted into launching an arrow when you release the string.

Hooke's Law states that the draw weight is proportional to the draw length. The greater amount that you deform the limbs by pulling them back further in your draw length, the more you increase the force that in turn increases the stored potential energy. Of course there's a limit to all that in both what your body is capable of drawing a bow and the bow's ability to withstand a limited draw length before it breaks. Fortunately, Mother Nature has taken care of that for most of us by limiting our physical "draw length" to around 28 to 30 inches.

Energy Conversion

Holding our bow at full draw, we now have stored a certain number of pounds of "elastic potential energy". The key word here is "potential". Because if we release the string without an arrow nocked on it, the energy isn't converted into much of anything, other than being reabsorbed into the limbs and bow, which in turn is called "dry firing" that can easily damage or break your bow. With an arrow nocked on the string, much of the stored energy is transferred to launching the arrow, though some of the energy remains in the bow.



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SPECIAL CONSIDERATIONS:

This activity is richest when completed in the classroom with discussion shared within the whole class. It may be helpful to create a guide sheet for notes with headings and questions to help guide students in picking out significant information.

VOCABULARY:

- **Longbow:** A traditional style bow with straight limbs that bend in a single uniform arch.
- **Recurve bow:** A traditional style bow with limbs that “recurve” forward near the limb tips.
- **Compound bow:** A modern bow that uses cables, cams and pulley system to alter the force-draw curve and shooting performance of the bows relatively short limbs.
- **Potential energy:** The energy stored in the bow’s limbs and string from the archers’ muscles drawing the bow.
- **Force/Draw Curve:** A graphic representation of the varying amounts of pounds per inch of pull throughout the draw length of a bow.
- **Release aid:** A mechanical device that allows the archer to draw and release the bowstring



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BEFORE VIEWING THE VIDEO:

1. **Before watching the video**, ask students what forces they think a bow uses to launch an arrow. Discuss as a class what bow characteristics might be important to a fictional archery superhero. If students need more guidance, ask them to describe the physical process of shooting a bow and arrow.
2. **Lead the class into a discussion** about how different bow designs might convert different amounts of stored potential energy into arrow velocity. Ask students with archery experience how different force/draw curves from different bows might affect energy conversion.
3. **Ask students with archery experience** to explain some of the advantages of shooting different types of bows. Help lead the discussion about how the “let-off” of a compound bow might allow for greater accuracy as it relates to the physical process of shooting a bow. How might a recurve or longbow allow for fast shooting?
4. **Tell students to write down questions** they have while watching the video. Some important questions to discuss include:
 - What are the differences between the three types of bows?
 - What role does an archer play the physics of archery?
 - How is the energy in a bow converted when the bowstring is released?

VIEWING AND DISCUSSION GUIDE:

After watching the video, give each student a blank piece of paper. On one side, have them draw three types of bows used by superheroes and label the type of bow. On the other side, have the students write down three reasons why each bow might offer advantages for an archery superhero. Then lead a classroom discussion exploring the following questions. Encourage varying opinions and debate.

Superheroes and their bows

1. Have students explain why they like a particular archery superhero from the movies or comic books.
2. Identify what type of bow their superhero shoots.
3. Discuss what advantages or limitations a certain bow design may have in a particular superhero challenge (such as fast shooting at a pack of charging baboons, or shooting through android armor).
4. Have them discuss what type of bow they would like to shoot and why?

Becoming an archer – Explain that although archery superheroes are fictional characters, anyone can become a real archer. Lead a discussion on:

1. Have students identify the various ways people use archery today (Target shooting, Olympics, bowhunting, bowfishing).
2. Have students discuss the ways they could get involved in trying archery – such as NASP. Encourage students with archery experience to help lead the discussion.
3. Have students discuss the physical and physiological benefits of archery as well as safety concerns.



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EVALUATION:

Students can be informally assessed from their notes taken before and after viewing the video and from their level of participation in class discussion.

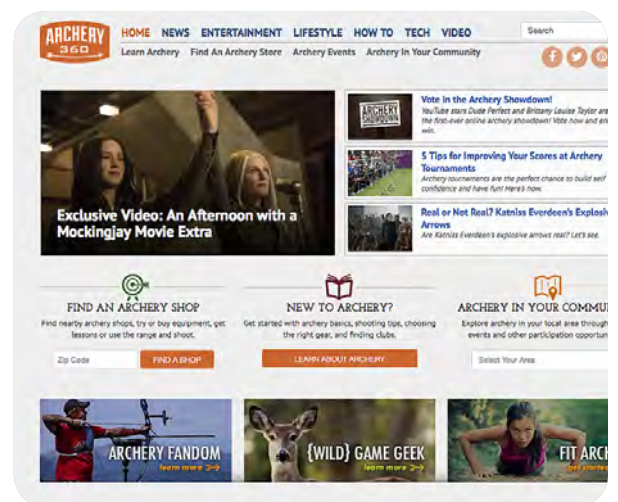
EXTENDED LEARNING:

1. Instruct students to conduct online research and prepare a presentation about careers associated with the archery industry that would require an understanding of various fields of science and physics.
2. Students can interview other students who have experience in archery, or persons at a local archery club or archery shop. Ask them to explore the reasons why people in the 21st century would want to shoot an ancient weapon such as a bow and arrow. Present their findings to the rest of the class.
3. Have students interview someone who has shot both tradition longbows or recurves and compounds. Have them explore the reasons why someone would want to shoot older style bows when highly efficient compounds are much easier to shoot. Present their findings to the rest of the class.



REFERENCES:

- <http://www.archery360.com/>
- <http://naspschools.org/>
- <http://www.teamusa.org/USA-Archery>
- <http://www.olympic.org/archery>
- <http://www.archery360.com/archery-stores/?address=&radius=100>
- <http://www.bowhunting.com/>



EDUCATIONAL STANDARDS:

Teachers: Please evaluate this guide for the Educational Standards in your state. We encourage you to please email those standards to us so we can add them to this webpage.

