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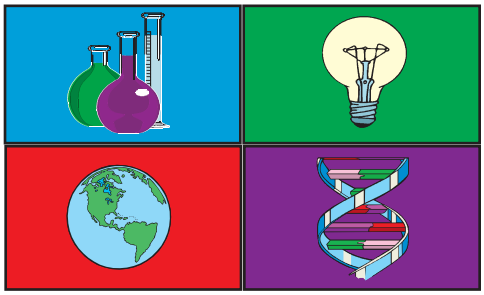
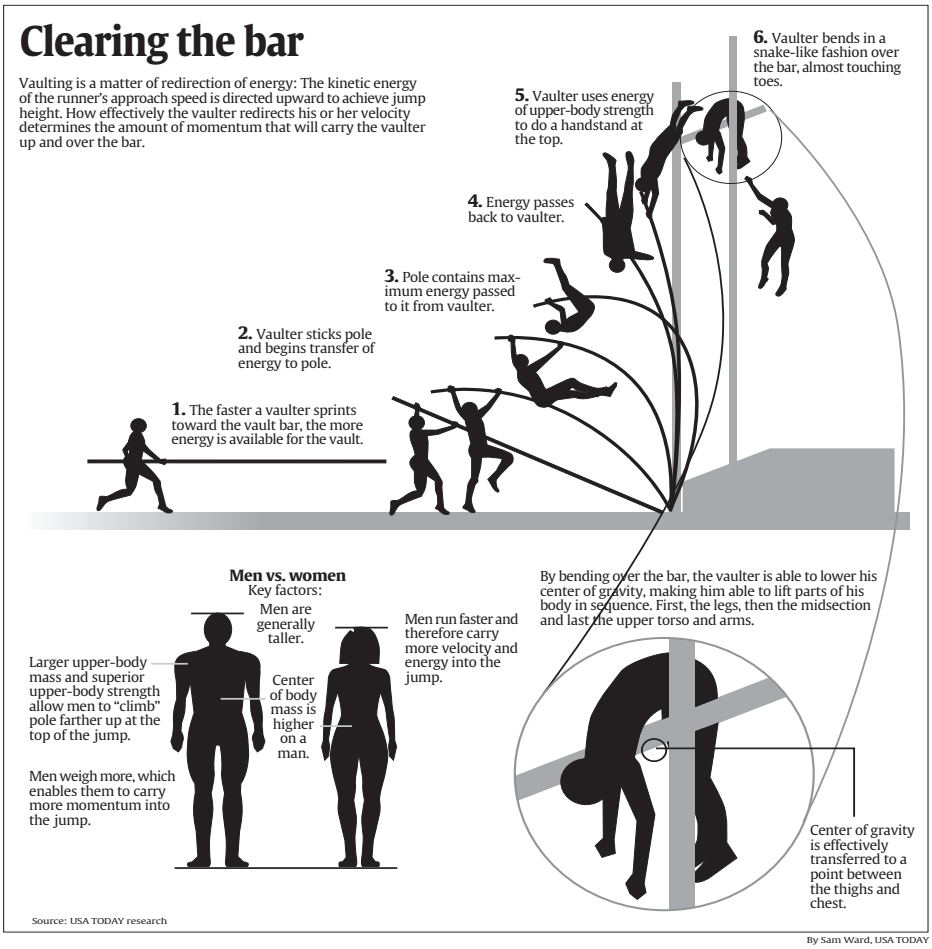


Clearing the bar



Activity Overview:

The pole vault is, arguably, the most technical track and field event, as well as the most dangerous. World-class vaulters are amazing athletes who possess equally amazing courage. To be sure, the pole vault is not an event for the faint-of-heart! While the men's pole vault has been around for decades, it wasn't until the 2000 Sydney Games that the women's pole vault became an Olympic event. Currently, the World record for the men's pole vault is just above 20' and the women's record is over 16'. In this activity, you will explore the two major factors that determine how high an individual is able to vault. Believe it or not, neither factor has to do with improved equipment or other technological advances. The two factors are the height of the vaulter and the speed that he/she achieves on the runway prior to the vault. Using these physical features, you will predict how high YOU should be able to (theoretically!) vault.

Focus Questions:

- Using your own height and speed, how high should you be able to pole vault?
- If given the height and speed for certain world-class athletes, how high should they be able to vault?
- What other factors affect vault heights?

This activity was created for use with Texas Instruments handheld technology.

Clearing the bar

Procedure:

Step 1
Measure your height in meters. _____ meters.

Step 2
Measure a 30 meter distance on a track, in a hallway, or on an outdoor playing field. Mark the starting and finish lines. In addition, place a marker at the 10 meter mark.

Step 3
One person in the group will be the timer, one will be the runner and one will be the "starter". The runner is at the starting line, the timer is at the 30 meter point and the "starter" is at the 10 meter point with his/her arm raised.

Step 4
The runner will start sprinting whenever he/she is ready. As soon as the runner reaches the starter (at the 10 meter line), the starter will drop his/her hand and the timer will start the stopwatch. This indication will give the runner a chance to reach full velocity for accurate data. When the runner crosses the 30 meter line, the timer stops the stopwatch. You now have a distance (20 meters) and the time it took to run that distance. Use your graphing calculator to calculate the velocity in meters/seconds.

Step 5
Now, rotate positions so that the runner becomes the timer, and so on. Every person in the group should take two turns in each role. Make sure you record your times. When all of the times have been collected, each person should calculate the average of their two times — then remember to convert to m/sec!

Trial 1 _____sec Trial 2 _____sec Avg.Time _____ sec
Avg.Velocity _____ m/sec

Now that you have measured your height and calculated your velocity when you are running, you can use a formula to predict how high you should be able to pole vault.
If you are a female, use this formula: **$h = 0.55 * [\text{female height}] + \frac{1}{2}(v^2/g)$**
If you are a male, use this formula: **$h = 0.60 * [\text{male height}] + \frac{1}{2}(v^2/g)$**

Where:
- "h" is the estimated maximum vault height.
- 0.55 (or 0.60) is the approximate location of your center of mass. For example, a man who is 2 meters tall would have a center of mass that is about 1.2 meters above the ground, while a woman of the same height would have a center of mass 1.1 meters above the ground.
- "v" is your sprint velocity that you calculated.
- "g" is the force of gravity, which is a constant 9.8 m/sec^2.

For example, a man 2.0 meters tall who runs 8.5 m/sec,
h = 0.60*(2.0 m) + 0.5*(8.5 m/sec)2/(9.8 m/sec^2) = 4.9 m.

Data Source:

USA TODAY research

Materials:

- TI-83 Plus family or TI-84 Plus family
- Science Tool APP
- TI-Navigator system, if available
- Stopwatch
- Tape measure

Additional Information:

- "The Physics of Pole Vaulting" website:

  www.aip.org/png/html/polevault2.html

Clearing the bar

Assessment and Evaluation:

1. The 2000 Olympic women's pole vault Gold medalist was Stacy Dragila from the United States. Stacy is 5'8" tall and her sprint speed is 8.33 m/sec. Calculate the height in meters that Stacy should be able to vault. Don't forget to convert Stacy's height to meters. You may wish to use the SciTools APP on your calculator.

2. Using the SciTools APP on your graphing calculator, estimate how high Stacy's vault would be in feet and inches?

3. If a man is 6'4" and can run at a velocity of 9.65 m/sec, how high should he be able to vault in meters?

4. How high would this be in feet and inches?

5. What are some other factors that would affect the height that someone could vault?

6. What is your estimated vault height?

Student Notes: