

Hooke's Law:

Grade: 11th - 12th

https://phet.colorado.edu/sims/html/hookes-law/latest/hookes-law_en.html**Brief Notes:**

- When a spring is stretched/compressed, force by the spring is given as:

$$F = -k \cdot x$$

- In parallel connections, load gets distributed among springs. Whereas in series connections, same load acts along all springs.
- When spring is compressed/stretched, work is done against spring force. This work is stored as energy, called as Spring Potential Energy. It is given as:

$$U = \frac{1}{2} k x^2$$

Explore:**Intro: Single Spring**

1. Click on Applied Force, Spring Force, Displacement, Equilibrium Position and Values. Which point is taken as reference to measure spring displacement? Free end or fixed end? (**Ans:** Free end)
2. Stretch/compress the spring. What is the relation between Applied force and Spring force, in terms of direction and magnitude?
3. When spring is stretched/compressed, what is the relation between directions of Spring Force and its displacement?
4. For a spring constant of 200 N/m, when you apply 100 N force on spring, what will be its displacement? Verify it using formula: $F = -k \cdot x$
5. Keep the force 100 N. Increase value of spring constant. How does displacement change?

Systems:

6. Click on Applied Force, Spring Force, Displacement, Equilibrium Position and Values.

Parallel Connections:

6.1 What is the relation between displacements of both springs, when a load is applied?

6.2 Take both springs of same spring constants, apply some load. Will they share load equally?

6.3 Take both springs of different spring constants, apply some load. Who will share more load and why?

Series Connections:

6.4 Take both springs of same spring constants. Apply some load. Which spring share more load? Which spring has more displacement? Explain reason for your observation.

6.5 Now, take both springs of different spring constants. Apply some load. Which spring share more load? Which spring has more displacement? Explain reason.

6.6 How do you find out total displacement for series connection of springs?

Energy:

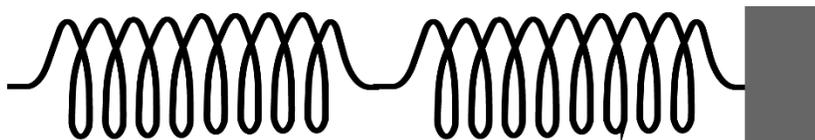
7.1 Stretch/compress spring. How does the potential energy of spring change with its displacement? Mark the points of max and min potential energy. Explain the reason.

7.2 How does the graph of potential energy change, when spring constant increases?

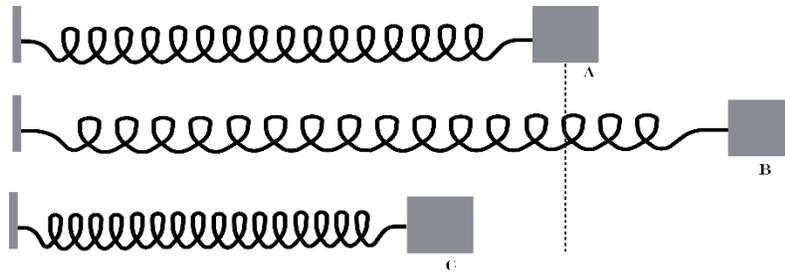
7.3 Click on Force Plot. How does the Applied Force v/s Displacement look like? How the slope of this graph is related to spring constant?

Think:

1. Why springs in trucks are stiffer than that of springs in bikes?
2. Two springs (spring constants are 210 N/m & 360 N/m) are connected in series. A load of 100 N is applied at free end. Find out individual displacements and total displacement.



3. A block is kept on a frictionless horizontal floor and attached with spring. When it is released, at which point, it will have largest velocity?



4. Why springs are used as shock absorbers?

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