

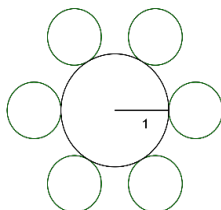
## Math Challenge: Portions of Sound Energy

### Key Science Ideas

- Sound travels in all directions.
- As a listener will receive a smaller portion of a sound as he or she moves farther away from the source.

### Scenario

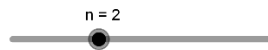
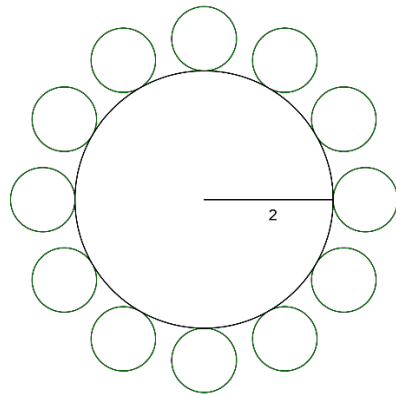
1. Six listeners are arranged side by side in a circle around a soundmaker. Each listener is the same distance away from the soundmaker.
  - The source of the sound is at the center of the large circle.
  - Each small circle represents a listener.
  - Assume that these six listeners are the only ones who receive the sound from the source. Ignore the gaps between the listeners. They have very big ears.



Look at the figure above. If we use the value of 60 units to represent the total amount of sound energy in this sound, how many units of sound energy will each listener receive at this distance from the source if the distance is  $n = 1$ ? Write your answer below.

At a distance of  $n = 1$ , each listener will receive \_\_\_\_\_ units of sound energy in his or her big ears.

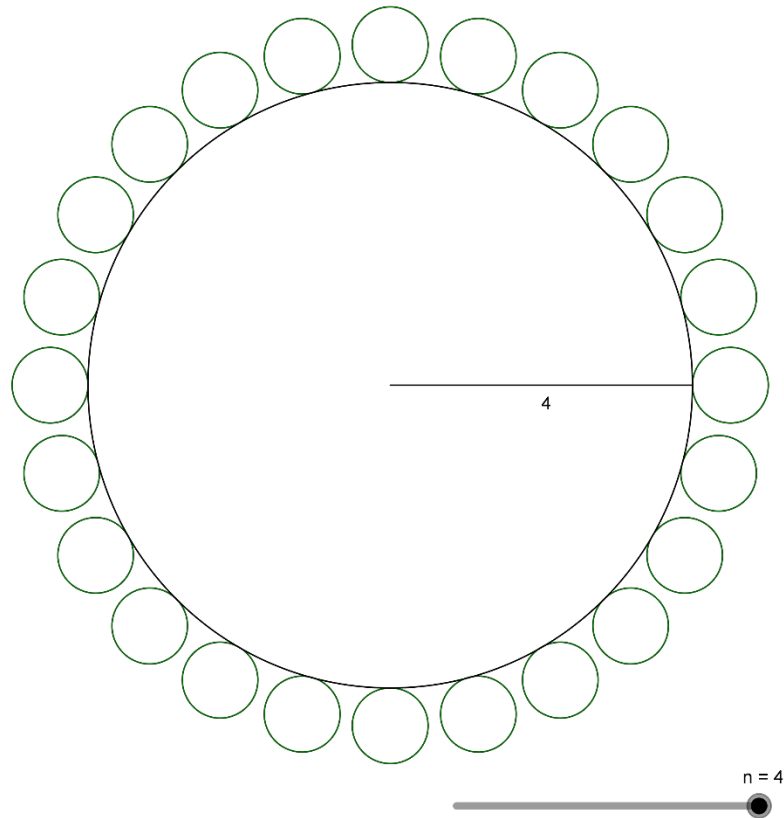
2. Now 12 listeners are arranged side by side in a circle around the same soundmaker. Each listener is *twice* as far away from the soundmaker as before (the distance is  $n = 2$ ). The same value of 60 units represents the total amount of energy in the sound.



If the soundmaker makes the same sound as before, how much of the sound energy will each listener receive now? Write your answer in the blank below.

At a distance of  $n = 2$ , each listener will receive \_\_\_\_\_ units of sound energy into his or her big ears.

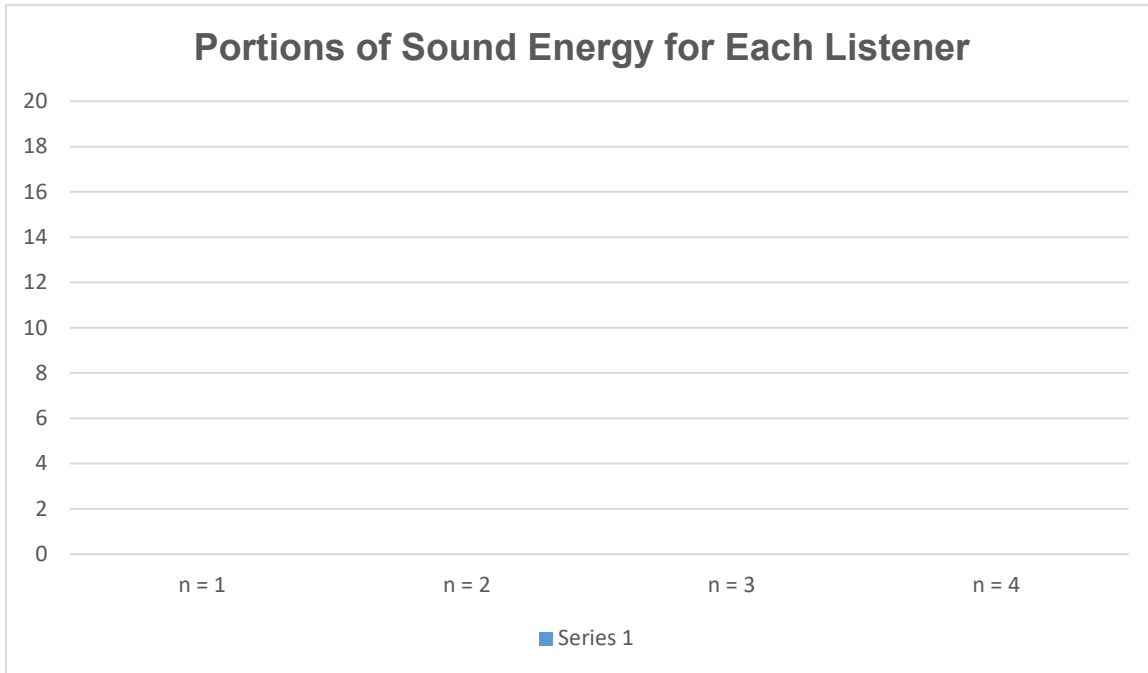
3. Now there are 24 listeners sitting side by side in a circle around the same soundmaker. Each listener is *four times* as far away from the soundmaker as before (the distance is  $n = 4$ ). The same value of 60 units represents the total amount of energy in the sound.



If the soundmaker makes the same sound as before, how much of the sound energy will each listener receive now? Write your answer in the blank below.

At a distance of  $n = 4$ , each listener will receive \_\_\_\_\_ units of sound energy into his or her big ears.

4. Now let's graphically represent the portion of sound a listener receives in each of scenario. How can we represent our data in a way that shows that the portion of sound a listener receives changes as distance from the source increases? Sketch this in the area below.



### Challenge Questions

- What happens to the sound energy as the circle gets larger?
- Why does a sound get softer as we move farther away from the source?
- What do you think would happen if you had very, very big ears?
- What if 4 units of sound energy from a nearby, noisy freeway reached *everyone's* ears? In which scenario would listeners have the most difficulty hearing the sound coming from the center of the circle? Why?