

Inverse Square Law

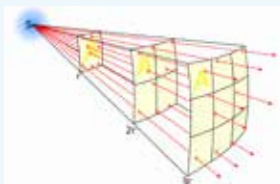
(Italy)

Background

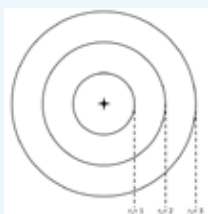
A look at how the hidden mathematics in fruit and vegetables can help in understanding some important concepts, reveals a simple model of the Inverse Square Law using oranges.

If you wish to use the images shown here, they can be accessed through this link bit.ly/SonS2019

The Inverse Square Law states that a specified physical quantity is inversely proportional to the square of the distance from the source of that physical quantity. The intensity of starlight, or emissions from a mobile phone mast, may be represented as in Fig. 1. The intensity decreases rapidly the further you are from the source.



This can be imagined as a set of concentric spheres with increasing radii, like layers of an onion, as in Fig. 2.



This is a difficult concept for students to grasp. However, if the skins of two oranges, of diameters d and $2d$, are peeled and the area they cover compared, there should be a 4:1 ratio as in Fig. 3.

You will need:

- ✓ A large orange
- ✓ A small orange (half the diameter of the large)
- ✓ Laminated 1 cm² grid paper
- ✓ Vernier calliper
- ✓ Calculator
- ✓ Dry wipe marker

Follow these steps:

1. Find two oranges of diameters d and $2d$, using Vernier callipers
2. Peel the large orange and place its skin flat onto the grid paper as in Fig. 4.
3. Repeat for the smaller orange.
4. Rounding to the nearest cm allows you to calculate the ratio in whole numbers.



So what happened?

As a statement, law or diagram this can be a very abstract concept. Using oranges concretises the concept in a manageable way without undermining the principle you wish to show.

It also allows the students to image concentric spheres, sitting in layers like an onion, with the centre being a point source of energy/radiation, that becomes weaker the further from the centre it is as the same amount of energy has to be spread over a much larger area (which is a sphere in 3 dimensions).

What next?

- JC Science Earth & Space – a backwards working of the light intensity from a star allows astronomers to calculate the distance of stars from Earth, in conjunction with light intensity data of stars built over centuries.
- This law can also be used to explain why mobile phone masts are considered safe as any radiation emitted by them drops off very quickly after a short distance.