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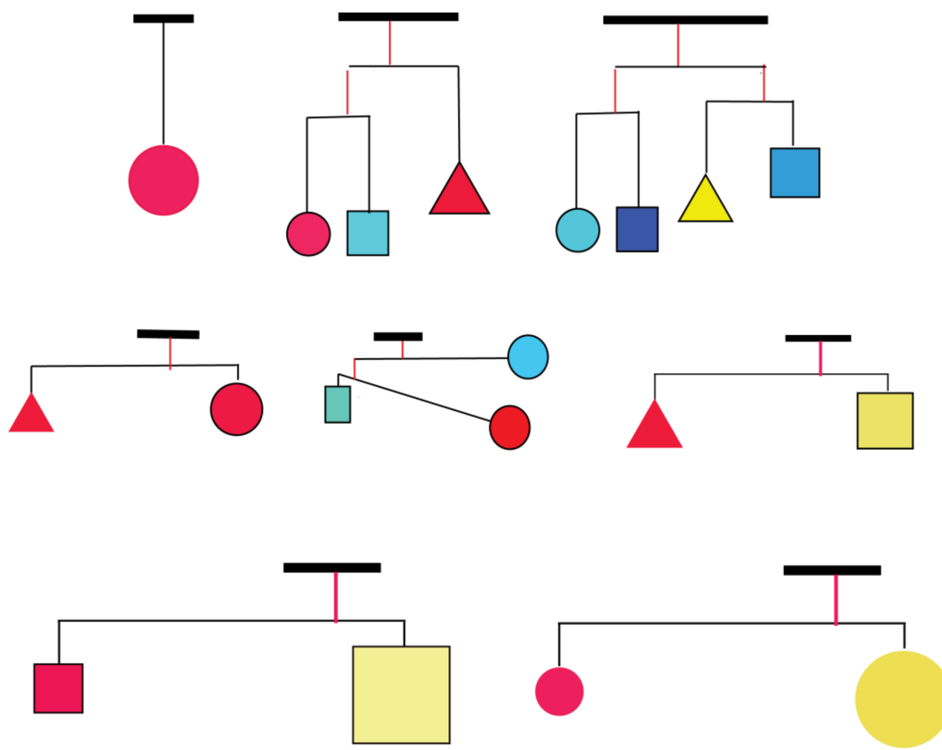
Mobiles and Science

Mobiles: they are like living creatures with their own personalities--humorous, meditative, or graceful. They can be a great teaching tool for basic physics, algebra, trigonometry and also calculus. The essence of any mobile is its balance. The balance can be found two ways: there is an empirical way, which involves experimentation by hand and eye, trial and error. And for those with curious minds there is one more way—the scientific way. Combining this empirical sense of the balance of mobiles with calculations based on physics and mathematics sharpens our understanding. This way art and science come together.

To explore this idea, let's consider a group of mobiles:



The mobiles shown above are made from four essential elements: 1.) objects with simple geometric shapes--circles, rectangles, and triangles; 2.) horizontal and oblique straight lines--metal or wooden rods--connecting the objects; 3.) vertical straight lines--threads or filaments, shown here in black--attaching the objects to the rods; and 4.) vertical lines, shown here in red, that connect the elements of the mobile to their points of balance.

(For teaching geometry, this would be a good moment to discuss the geometric properties of these shapes.)

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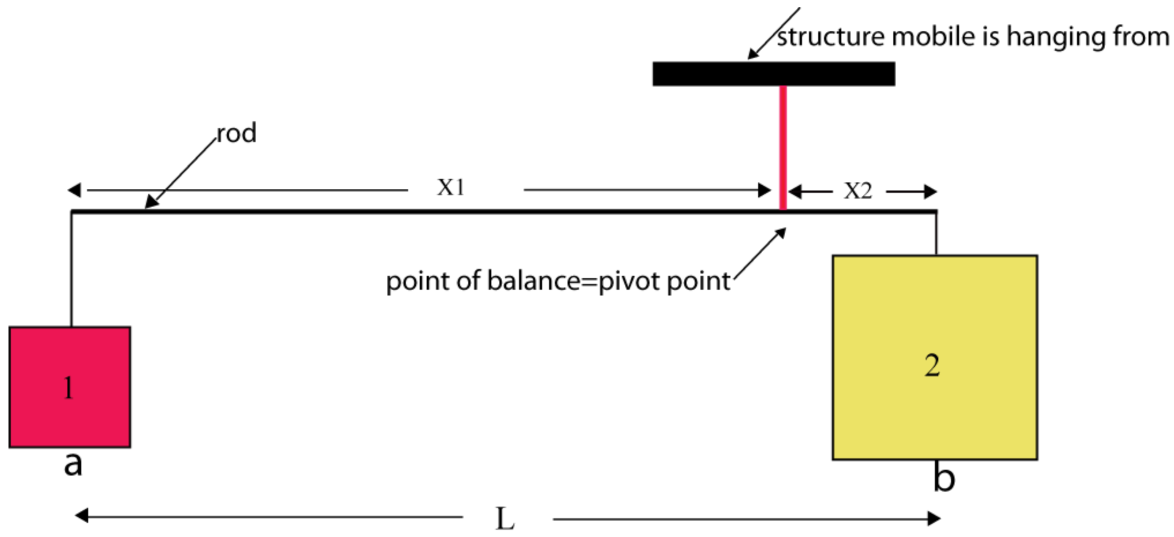
As an example let's consider the simplest mobile below. The points of balance can be calculated exactly using elements of physics of balance and algebra. This mobile consists of two squares: "1" (the red square on the left) and "2" (the yellow square on the right) hanging from both ends of a rod, which has length L. For now we will ignore the weight of the rod.



The point of balance Xc for these two squares can be calculated from the following formula:

$$X_c = \frac{M_2}{M_1 + M_2} L = \frac{\rho_2 b^2}{\rho_1 a^2 + \rho_2 b^2} L$$

Where:

a - length of a side of the square "1"
A_1 - area of the square "1"
ρ_1 - density of material of the square "1"
M_1 - mass of the swquare "1"
b - length a side of the square "2"
A_2 - area of the square "2"
ρ_2 - density of material of the square "2"
M_2 - mass of the square "2"

$$M_1 = \rho_1 A_1 = \rho_1 a^2$$

$$M_2 = \rho_2 A_1 = \rho_2 b^2$$

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If the densities of materials for these two squares are equal, we will get:

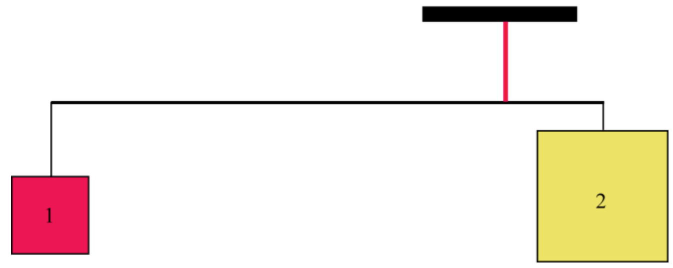
$$X_c = \frac{b^2}{a^2 + b^2} L$$

And if, for instance

$$b = 2a$$

We will get the following numerical result:

$$X_c = \frac{(2a)^2}{a^2 + (2a)^2} L = 0.8\,L$$



Now you can make a mobile that looks like the one in the picture above. Then compare the point of suspension that makes the mobile balance with the one you got from using the formula, and you will see that both methods get you to the same result.

We can use mathematics and physics to calculate more complex configurations, and we can always compare our empirical results with the scientific ones.