**The Parabola**
When Sun light (parallel rays) falls onto a correctly aligned parabolic mirror it will be reflected back towards a single point known as the focus. The parabolic mirror therefore directs the energy arriving over its surface to a 'hot spot' at the focus. You can use this energy to heat something.

The basic shape of a parabola is derived from the equation:

$y^2 = 4ax$ [1]

Where y represents the distance away from the mirror centre and x represents the 'height above' the centre, see figure 1 and 2. The constant a is known as the focal length - the distance from the origin to the focus point.

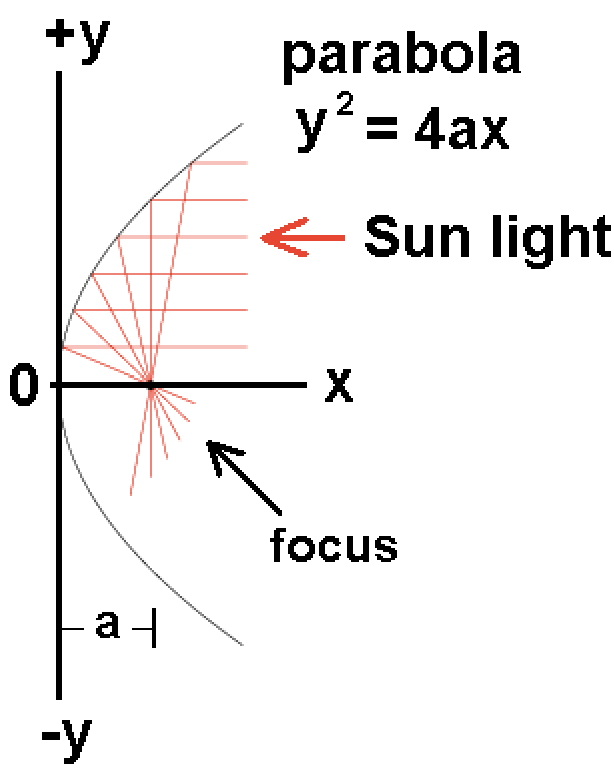


**Figure 1. The basic geometry of a parabola mirror. Light rays coming from infinity will tend to be reflected towards a point called the focus.**

If we want to make a parabolic reflector to our own particular specification i.e. in terms of its size D (i.e. having maximum y = D/2), height h and focal length a, then equation 1 becomes:

$a = D^2/16h$ [2]

A simple curved plane (rather than dish shape) solar heater is shown in photo 1 and we shall use this as an example, of course what follows can also be used for a full 'dish shaped' parabola and for much larger designs.

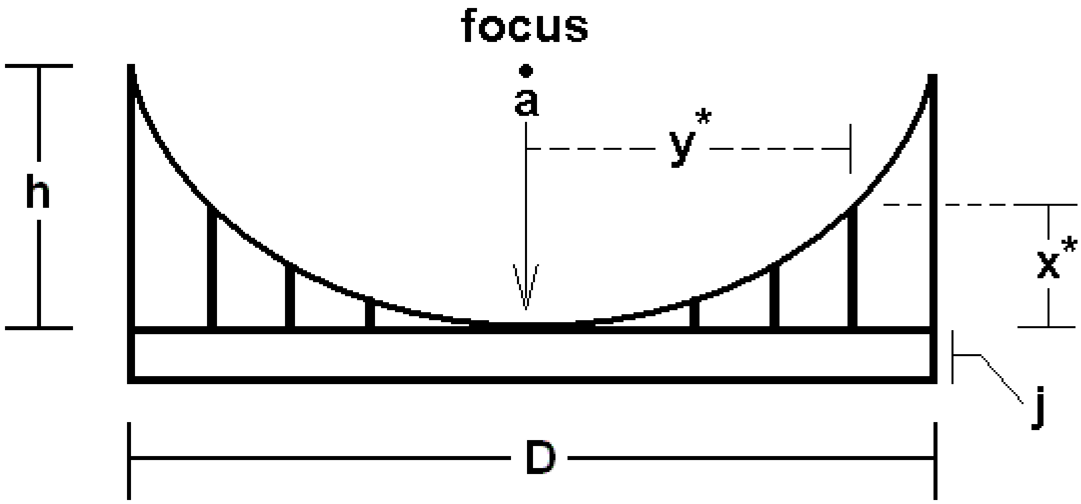


**Figure 2. Parabolic surface made using i) a cut-out template or ii) by thin sheet fixed to vertical wooden supports. The position (y*) and height (x*) of each support (point) is calculated from the equation 1 and 3. A set of x and y values for the model in photo 1 is give in table 1. D-length, h-height, a-focus and j (an offset used to make the template version, see text).**

To make it easy to locate the focal point when we are using it, I chose to design the mirror surface height (h) to be the same value as a - the focus distance above the canter of the mirror (so a = h in this example 11 cm). In this case finding the focus is simple - imagine a line going across the top of the device, the centre of this line is where the focus is.

Rearranging equation 2 we get the diameter / length of the solar heater D to be:

$D^2 = 16ah$, so using h = a = 11 cm we get:
$D = \sqrt{(16 \times 11 \times 11)} = \sqrt{(1936)} = 44$ cm

We have $y^2 = 4ax$ and a = 11 cm
For the solar heater shown in photo 1 we get $x = y^2/44$
[3] (all dimensions in cm)

Now that we have chosen the basic quantities for the parabola we can compute the x and y coordinates from equation 1 and 3. Some of these are tabulated in table 1. To re-cap, the y axis represents the distance away from the mirrors centre while x represents the 'height' above the base, the lowest point of the mirror (its centre).

You can also make a parabola support by cutting two side (parabola shaped) templates, see photo 1. In this case when marking up simply add a few cm (j in figure 2) to all the x values otherwise the template will diminish to zero thickness at the centre and it will all fall apart!

**Table 1 - y and x values derived from equation 3 for the parabolic solar heater shown in photo 1.**

| **±y (cm)** | **$y^2$** | **$y^2/44$** | **x (cm)** |
|---|---|---|---|
| 0 | 0 | 0 | 0 |
| 1 | 1 | 1/44 | 0 |
| 2 | 4 | 4/44 | 0.1 |
| 3 | 9 | 9/44 | 0.2 |
| 4 | 16 | 16/44 | 0.3 |
| 5 | 25 | 25/44 | 0.6 |
| 6 | 36 | 36/44 | 0.8 |
| 7 | 42 | 42/44 | 0.9 |
| 8 | 64 | 64/44 | 1.5 |
| ... | ... | ... | ... |
| 20 | 400 | 400/44 | 9.1 |

and so on for larger values of y