In the tutorial, you calculated the electric field of a charged plane of infinite area. The field turned out to be independent of distance. This property makes it easy to analyze systems of many charged sheets and slabs using **superposition**.
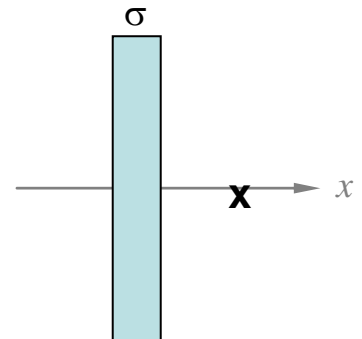
Here's a warmup exercise: consider the thick slab of infinite area shown at right. The slab is made of a non-conducting material. It carries a net charge per unit area of σ, which is distributed uniformly throughout the interior of the slab.

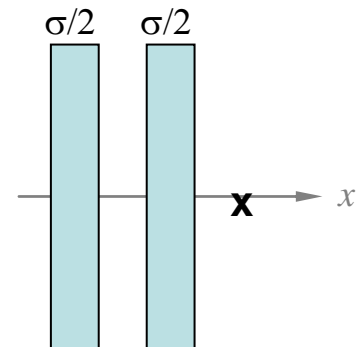(a) Write down the electric field E at the point **x**.

(b) Would the field change if the slab were moved **further to the left**?

(c) Would the field change if the **thickness** of the slab were increased?

(d) Would the field change if the slab were replaced by **two slabs**, each carrying charge density σ/2?

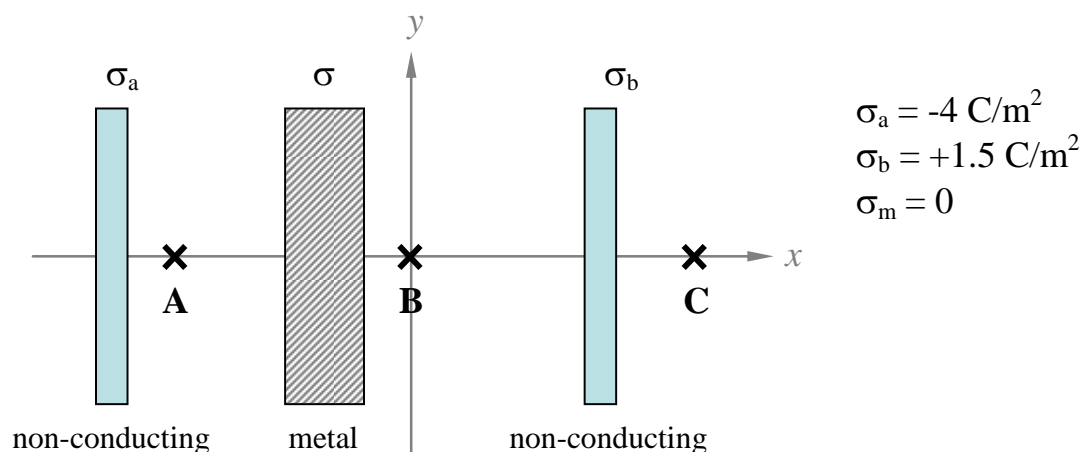See how easy superposition is with infinite planes? ☺

Let's also remind ourselves how to deal with **conductors**. Suppose that the slab described above were made of metal instead of non-conducting material … what would change?

(f) Would the field **outside** the slab (e.g. at the point **x**) change?

(g) Would the field **inside** the slab change?

(h) Would the **distribution of charge** within the slab change? How so?

Now that we have all the ingredients, let's analyze a more complicated system.

$\sigma_a = -4 \text{ C/m}^2$
$\sigma_b = +1.5 \text{ C/m}^2$
$\sigma_m = 0$

Two non-conducting slabs of infinite area are given a charge-per-unit area of $\sigma_a = -4 \text{ C/m}^2$ and $\sigma_b = +1.5 \text{ C/m}^2$ respectively. A third slab, made of metal, is placed between the first two plates. The charge density σ_m on the metal slab is 0 (i.e. the slab is uncharged).

(a) Find the magnitude and direction of the electric field at the points A, B, and C.

(b) Now let's think physically about the metal slab. The defining property of a conductor is that the charges within are *free to move*, and they will do so in response to an electric field. As a result, surface charges σ_L and σ_R will accumulate on the left- and right-hand surfaces of the slab. What are the *signs* of these surface charges?

(c) Go ahead and use Gauss' Law plus your answers to question (a) to calculate the surface charges σ_L and σ_R induced on the metal slab.

(d) Finally, let's add a *net* charge per unit area of $\sigma_m = +3$ C/m^2 to the metal slab. Now what are the surface charges σ_L and σ_R?