$\Diamond\heartsuit$ Oriented (or 2-sided) Surfaces $\heartsuit\Diamond$

We say a surface S is oriented (or orientable) if it has a unit normal vector $\vec{n}$ at each point (x, y, z) not on the boundary of the surface and if $\vec{n}$ is a continuous function of (x, y, z).

Further, we assume that S has two identifiable sides (a top and a bottom or an inside and an outside). To orient such a surface , we choose a consistent direction for all normal vectors.

For instance, a sphere is a two-sided surface; the two sides of the surface are the inside and the outside. Notice that you cannot get from the inside to the outside without passing through the sphere.

The positive orientation for the sphere (or any other closed surface) is to choose outward normal vectors (normal vectors pointing away from the interior)

One reason we need to be able to orient a surface is to compute the flux of a vector field. It's easiest to visualize the flux for a vector field representing the velocity field for a fluid in motion.

In this context, the flux measures the net flow rate of the fluid across the surface, that is, from the inside to the outside.

(Notice that for this to make sense, the surface must have two identifiable sides. That is, the surface must be orientable). The orientation of the surface lets us distinguish one direction from the other.