G-maps and G-orbits

Let G be a group. Let S and S' be two G-sets. A map

$$f\colon S \to S'$$

is called a G-map, or a morphism of G-sets if

$$f(xs) = xf(s)$$

for all $x \in G$ and all $s \in S$.

Let G be a group and S a G-set. Given an element $s \in S$, the map

$$\begin{aligned} G &\to S \\ x &\mapsto xs \end{aligned}$$

is a G-map. Its image, Gs, is called the orbit of s.

If $Gs = S$ for some $s \in S$, we say that the action of G on S is transitive, or simply that S is a transitive G-set.