Introduction to Symmetries in Physics

Program:

I- Introduction

I1-Symmetries are everywhere in Physics
* Geometrical symmetries of the direct space in electromagnetism, crystals...
* Space transformations keeping a solid: change of frames
* Discrete symmetries: left/right, time reversal, conjugacy, supersymmetry...
* Scaling
* Noether's theorem
* Gauges (local/global)
* Symmetry breaking (spontaneously or not)

I2-A constructive example: Lorentz transformations without the speed of light postulate

II-The group structure

* Generalities
* Homomorphisms
* Subgroups
* Group actions

III-The symmetric group Sn

* Definitions
* Decompositions (in transpositions, in disjoint cycles...)
* Signature
* Normal subgroups

IV-Symmetries of Euclidean spaces, isometries in dimension 2 and 3

* Definitions
* The (special) orthogonal group: On, SOn
* Dimension 2: translations, rotations, reflections