Group actions, symmetrical graphs, and edge-transitive maps

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The incidence graph of a classical projective plane is highly symmetrical. An interesting question is whether it has a highly symmetrical embedding in a Riemann surface. In general, given a family of graphs, such as 2-arc transitive graphs or vertex-primitive graphs, it is a natural problem to ask whether they have edge-transitive embeddings, and further to determine such embeddings (if any). This problem is tightly related to the theory of groups generated by two elements or three involutions, and factorizations of groups. I will report on recent progress on this problem, based on factorizations of almost simple groups, which shows the importance of group theory in the study of graphs and maps.