Freeze water and you get a solid block of ice. Freeze salt water and you get a porous matrix of pure ice crystals whose pores are filled with concentrated brine. Such is the texture of a popsicle, of sea ice formed when oceans freeze and of a metallic alloy during casting. Segregation also occurs when suspensions of solid particles are frozen, and is then accompanied by very high pressures that can fracture rocks and damage roads and building foundations. More constructively, the freezing of colloidal suspensions is being investigated as a means to fabricate ice-templated materials such as artificial bone. I will give an overview of the different phenomena that can occur during the freezing of multi-component systems, focusing on fundamental principles that have been revealed in laboratory experiments and giving a flavour of the sorts of mathematical modelling that can be used to understand and quantify these phenomena.

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