Magnets and magnetic fields are essential to almost every aspect of our lives, from the most fundamental science experiments, to medical applications like the MRI, to computers and cars and navigation, to beautiful effects like the aurora borealis. Magnetism has been known to exist for thousands of years, and yet requires 20th century physics (quantum mechanics) to understand the basic principles, such as what makes iron magnetic. Many Nobel Prizes have been given for discoveries related to magnetism and magnets also make some of the best and most fun "magic tricks" or demonstrations, like the superconductor-magnet levitation shown here:

I will explain why iron is magnetic, show how superconductors cause levitation by repelling magnetic fields, and also how the best magnetic fields are produced by superconducting magnets. I will discuss what the difference is between the permanent magnet in a car’s starter motor, and the magnetic materials used for computer hard drives. I will also talk about some of the most exciting topics in modern magnetism, such as what happens when you try to make magnets really small (a field known as "nanomagnetism") or when you try to blend together magnets and semiconductors in spintronic materials.

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