Iron Compounds are Not Magnetic

Most of the misconceptions that I cover are misunderstandings or misinterpretations of unclear concepts. This one has actually been stated in chemistry textbooks. When the chemistry book is discussing how a molecule does not exhibit the properties of the elements that make it up, they use the example that iron compounds are not magnetic. This is where they go wrong.

Many iron compounds are magnetic. If iron oxide was not magnetic, we would not have cassette tapes, video tapes, or credit cards. New research has shown iron oxide to be an effective contrast agent for MRIs. If iron oxide is not magnetic, it would not offer this advantage to doctors. The example usually given in chemistry textbooks is usually heating up iron and sulfur in a test tube. Iron and sulfur combine in a variety of ratios. Some of those ratios are magnetic and some are not. The different ratios are usually named after the mineral in which they are found, like pyrite which is an iron and sulfur compound. For example, FeS is called pyrrhotite and is magnetic so it is nicknamed "magnetic pyrite" because it looks like its non-magnetic cousin pyrite with the formula FeS_2.

There is also a problem in defining the word "magnetic." There are two conflicting definitions: 1) It sticks to a magnet and 2) It is magnetic itself and will attract iron objects to it.

The first definition is actually called "paramagnetism." Even pyrite is slightly para-magnetic. It will stick to a strong magnet even though it cannot be permanently magnetized on its own. Pyrhotite, elemental iron, and iron oxide (among other things) can be made into permanent magnets and are called either ferromagnets or ferrimagnets depending upon how many of their domains are aligned. Either ferri- or ferro-magnetic materials can be permanently magnetized.

Most iron compounds are either para-, ferri-, or ferromagnetic, crushing the myth that iron compounds are not magnetic.

This particular misconception does not really need to be crushed unless a previous teacher planted it in the students' minds. Instead, we just need to avoid teaching it in the first place. There are plenty of examples that do demonstrate the element/compound properties concept. For example, sodium is a highly reactive metallic element that bursts into flames when exposed to water. Chlorine is a toxic yellowish gas. When sodium and chlorine are combined, the result is sodium chloride or table salt which is a colorless crystalline solid that we put on french fries and dissolves in water. Carbon takes many forms such as diamond, graphite, and charcoal. Oxygen is a transparent gas that supports a flame. Carbon dioxide is a dense gas that is used to extinguish flames. There are also some examples that may confuse students. For example, lead is a very dense metal and lead compounds are also very dense. They do not look anything like lead, but they are dense and toxic just like elemental lead.

So, this is a misconception that is perpetuated by teachers and textbooks, not one that is a result of discrepant student experiences or student misunderstandings. Check your textbook and teach this topic carefully and we can eradicate this misconception almost immediately.

In order to alleviate the possible misconception that this new understanding may contribute to, I want to be very clear that the iron in our hemoglobin is NOT magnetic. So all of the magical magnetic bracelets and shoe inserts are not science based. I always wondered, even if the iron in our blood was magnetic how putting magnets on our skin could improve circulation, not retard it. No magnetic device that you can purchase from an infomercial has ever been shown to be effective.

So, to summarize, most iron compounds are magnetic and magnetic bracelets do not work. Also, compounds can sometimes exhibit some of the properties of the elements that make them up.