

5.1.2 The Defect Zoo

There are a lot of different defects, we have a veritable **zoo**. There is also an easy way of sorting "defects in crystals" into some meaningful categories.

- We do that all the time with other things. For example, we like to differentiate the basic category "living beings" into animals, plants, fungi, and so on; after that we differentiate "animals" into, for example, birds, lions, fish, slime worms and bankers (however small the difference between the latter two might be).

With defects the simple and time-honored sorting principle is:

1. "Zero"-dimensional defects or "point defects".

- These defects are very small in all **three** directions of space. As small as they can possibly be ("zero" dimension), and that means **atomic** dimensions.
Our old friend the **vacancy** is a good example of a zero-dimensional defect, and so is an **interstitial carbon** atom in iron (we'll see in a moment what that means).

2. One-dimensional defects.

- This means that along some (virtual) **line** running through the crystal, something is wrong. Atoms sitting on (or close to) that line see an environment different from that of a perfect crystal.
- There is only **one** basic kind of one-dimensional defect in existence, which we will call a "**dislocation**". Dislocations do tend to boggle the mind quite a bit as soon as we give them a closer look, sorry. However, they are of prime importance. Read the following sentence loud to yourself or whoever you can force to listen to you:

Adjusting the properties of your steel ultimately means that you deal with the dislocations in there.

- Now repeat it, just to make sure you got it.

Adjusting the properties of your steel ultimately means that you deal with the dislocations in there.

- So if we want to get answers to our still open "why" questions, we **must** deal with dislocations. They are at the very heart of the [metal bending industry](#).
Sorry. There is no shortcut. You must turn on your brain.

3. Two-dimensional defects.

- Something goes awry with your crystal on some (virtual) **plane**.
We already know one defect of this type; we just haven't thought about it in these terms: it's simply the **surface**. Atoms there, if they look around, certainly do not see only proper neighbors in their proper positions.
- Another two-dimensional defect easy to conceive is the good old **grain boundary** between two crystallites or grains in a [poly crystal](#).

4. Three-dimensional defects

- They are easy to conceive. For example, just make a hole in your crystal by taking out many atoms. You don't know how to do this without messing up the crystal? It's easy. There are two ways of doing it:
 - Make a lot of vacancies (you know how to do this: just make your crystal hot). Then see to it that they all cluster together, forming a vacancy agglomerate that is simply a little hole, better known as a "**void**".
 - Take a magic knife or, better, brain knife that allows you to cut around in a crystal any way you like. Then scoop out a hole. Rest assured that whatever you can imagine doing to a crystal with you brain knife, mother nature can and will do in reality. You simply need not worry about **how** it is done.

Working through that list is going to be our program for the next sub-chapter.

- So gird you loins, fetch your favorite poison for relaxation, and bear with me.