It’s Not My Fault to Mess Up the Room

When I was little, the most enjoyable moment in my painting class was the process of washing the painting brush. I would place the end of the brush in water and watch the color on the brush spontaneously dispersing, twirling and finally mixing with the water. As I grew up, I got to understand that the color mixes with water because the molecules in the paint and water are in constant, random motion. Random suggests that the colors can be anywhere they want in the water. However, why does this random motion not, even once, cause the colors to separate again, which is one of the random possibilities?

In fact, you will never see the colors separating by themselves, because for a separation to be visible, millions of paint molecules have to come together and remain that way for seconds, which is too long for those random moving molecules to stay fixed. It is easy to go from order to disorder; for example, my bedroom become more messed up as time goes on; it takes forever to find a certain item. The room readily becomes chaotic, unless I spend a whole morning to clean it up.

There are countless things that are possible but never seen once in daily life. If you leave an ice cream on a table and go hang out with friends, when you come back you will see your ice cream in liquid form. This happens because the surrounding air has a higher temperature than the ice cream and melts the ice cream by delivering heat.
to it. According to the law of conservation of energy, the ice cream will have more energy and thus a higher temperature. When ice cream is as warm as the surrounding air, the heat transfer will stop. Why is it not the other way around where the air sucks energy from the ice cream and cools it down instead? Energetically this is possible, but as we experience, heat does not go from a cold object to a hot object to make the hot hotter and the cold colder. In this scenario, if we consider the separation of the hot and the cold as an orderly arrangement of energy, then the heat transfer we observe in the case of the ice cream is essentially messing up the order by ceasing the temperature difference between the ice cream and its surrounding air. This is another example in which disorder does not go back to order by itself.

A more scientific term describing the degree of disorder is entropy. Instead of saying going from order to disorder, we describe the previous examples in terms of an increasing entropy in the system. The principle behind all these is the second law of thermodynamics, which states that the entropy in a closed system never decreases. This is to say, a closed system can only become less orderly.

The second law of thermodynamics has many implications. First of all, it specifies certain directions of some processes. In chemistry, it simply implies which reactions will take place and which will not under a given condition. Gases are usually the dominant components that give rise to high entropy because the molecules in gases can move freely and randomly. In a reaction where gases are involved, the reaction will usually favor the side with more gases because this way the entropy is higher. For reactions that take place in water solutions, ions contribute to the value of
entropy. Ions are free-moving clusters of atoms; they wander in water and bring more chaos to the solution system. If ions are produced in a reaction, the entropy will increase. A reaction is spontaneous if the thermodynamic factors - both energy and entropy - allow it to occur. Based on this principle, we are able to make chemical ice packs. Ice packs are energetically disadvantageous because they release energy and make themselves colder than the surroundings. However, the chemical reaction involved in the ice pack is a delicate process which causes the entropy to increase by a great amount. When you scrub the ice pack, you break a small bag which contains a solid that dissolves in water and decomposes into ions. Ions create disorder in the water solution and enable the reaction to occur spontaneously. Entropy plays a crucial role so that ice packs can save many patients from surgical pain.

Air-conditioners are irrational products. In summer, they prevent your room from becoming as hot as the outside. They seem to reestablish an orderly arrangement of air by cooling the indoors and ejecting the hot air to the outside (if you recall those tubes on the wall that expel hot air during summertime). Isn’t it going against the increase in entropy? Yes if you only consider the temperature difference established indoors and outdoors. However, the whole process is not spontaneous. Rather you need the machine and electricity to do this. The heat produced by the electric circuit and taken from the hot air is greater than the amount of cooling. What you use to cool down the air only makes the world hotter. How ironic it is to see that people are willing to deceive themselves if they are able to gain any temporal pleasure!

The concept of entropy also restricts the direction of time. As claimed in the
second law of thermodynamics, the entropy of a closed system, or essentially our universe, never decreases as time goes on. This has simply put time travel, one of the greatest fantasies of our time, into trouble because entropy also determines what happens and what does not. If we were ever able to go back in time in our universe, we would need a super powerful source of energy that comes from somewhere outside our universe to overcome the non-spontaneity of decreasing entropy in our universe.

The most terrifying result from the second law of thermodynamics is the heat death theory. Because entropy only increases, if our universe is a closed system, then finally our universe will reach a state where no order is present. Every possible energy transfer is achieved, so there is no more need to do work. Everything in the universe can do nothing but float randomly in space. We should feel lucky that the world we live in still possesses some sort of order. The heat death theory implants another thought that the universe is not infinitely old. If the universe were infinitely old, then according to the second law of thermodynamics it would be now completely orderless already, which is not the case. So the universe we live in must have an origin, or a beginning in time. At the beginning of the universe, the entropy must be a minimum. But another problem rises: who created and “organized” the universe in the beginning?

Entropy has been used to describe not only the intangible universe but also the daily world. In sociology, entropy usually refers to the disorder in a community, where order means a structured, nonconflictive society. Capital, including money and
resources, is the “energy” in the society. As in physics, energy is defined as the potential to do work; people who own more capital can purchase more goods and employ more people to work. Order maximizes the efficiency in a society, because it allows specialization to occur. Interestingly, most capital is consumed to maintain the order, which is essentially to ensure the functionality of different organizations. It includes the salaries given to workers and the resources spent to optimize the organizations. Entropy is also used in information technology. “Information entropy” indicates the disorder in an information system by measuring how many variables are needed to locate a certain piece of information. When information in a system is highly organized, it will be easy to find a certain thing. When the system is unorganized, more information will be needed in order to find where something is. The term entropy has been more or less given a philosophical significance that being organized is energy-consuming.

Although I agree that keeping my room tidy is important and beneficial, I always have an excuse for not cleaning it up. It is the nature of physics that misplaces every single object; why would I consume my energy on stopping that spontaneous reaction?
Reference


