5 Rusting and tarnishing

Rust is a change that affects ordinary iron and steel in water or damp air.

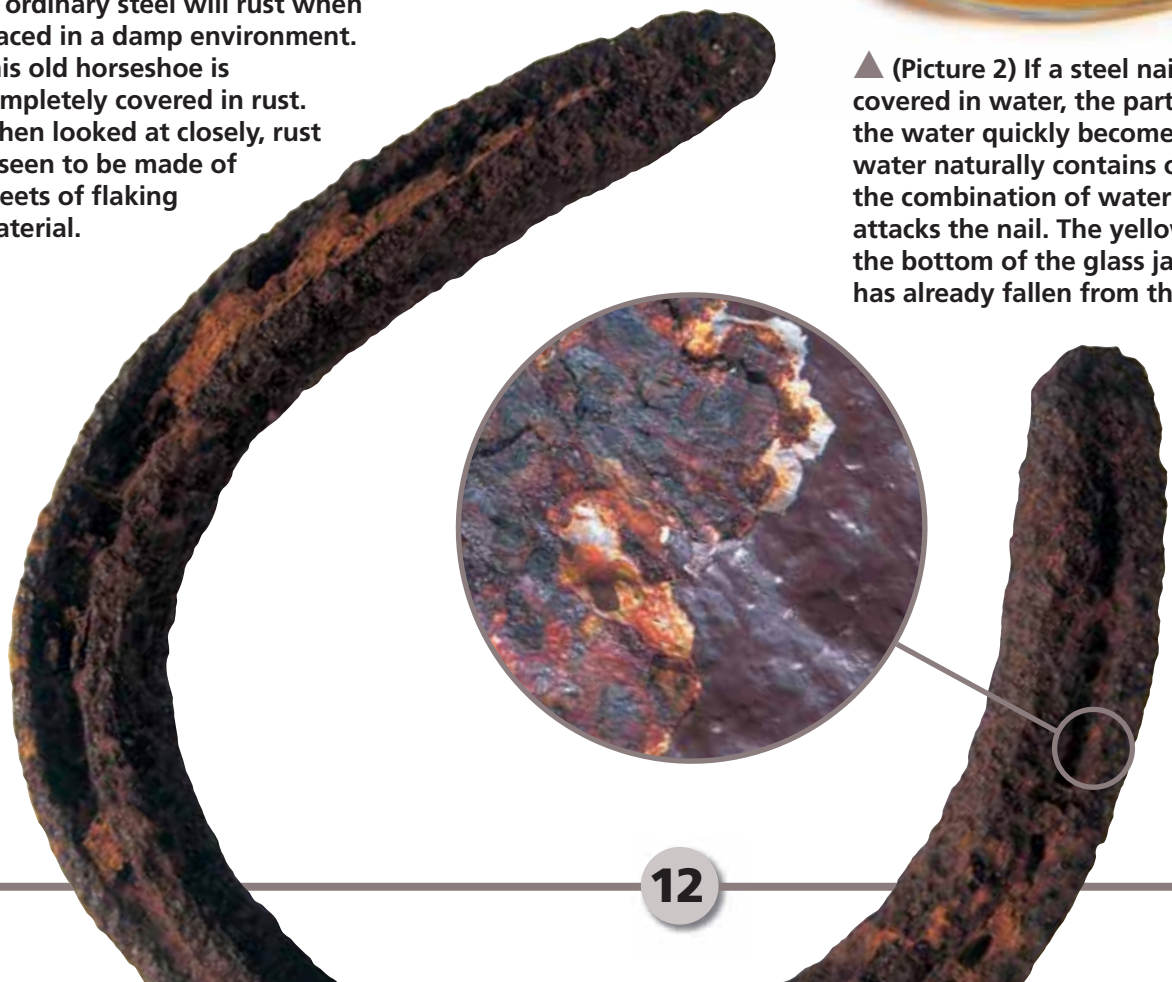
Being exposed to the air is a dangerous thing for many common metals. This is because many metals combine with the oxygen and other gases in the air to create a new material.

Rusting

Iron or **STEEL** are especially liable to combine with oxygen. When this happens the surface of the metal changes from shiny grey to dark brown. The surface develops pits and bumps, and flakes of **BRITTLE** material form (Picture 1). This is called **RUST**. It is an irreversible change.

▲ **(Picture 2) If a steel nail is half-covered in water, the part of the nail in the water quickly becomes rusty. The water naturally contains oxygen, so the combination of water and oxygen attacks the nail. The yellow material at the bottom of the glass jar is rust that has already fallen from the nail.**

▼ **(Picture 1) Anything made of ordinary steel will rust when placed in a damp environment. This old horseshoe is completely covered in rust. When looked at closely, rust is seen to be made of sheets of flaking material.**



Iron or steel will not combine with oxygen if the air is dry, however. This is why nails stay bright and shiny indoors. But as soon as water is present and the air gets damp, both metals rust quickly (Picture 2).

When iron combines with oxygen gas in the air, the material produced is made of both iron and oxygen, so it takes up more space. The more the iron or steel rusts, the thicker the coat becomes, until it finally breaks away as a flake of rust.

▼ **(Picture 3) When exposed to the damp air, copper turns from orange-red to green. This is what happened to the Statue of Liberty in New York harbour.**

Tarnishing

Many metals do not combine with oxygen as dramatically as iron and steel. Instead, they develop a thin, dull coating that actually seals the metal and protects it from further attack. This coating is called **TARNISH**. The green colour that develops on the surface of copper (Picture 3), and the brown and black stains on silver (Picture 4), are good examples of tarnishing.

Unlike rusting, which continues until all the iron is used up, tarnishing does not harm the metal underneath.

▶ **(Picture 4) This silver fork is partly covered in black tarnish.**

Summary

- **Many metals combine with oxygen and other gases in the air.**
- **When iron and steel combine with oxygen and water, it causes rusting.**
- **Most metals combine with oxygen to form a thin, coloured, dull coating called tarnish.**