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The nose knows

Rust doesn’t appear to release molecules into the air. So why does it have a smell?

**Stefan Badham**
*Portsmouth, Hampshire, UK*
Rust is another name for iron oxide. It occurs when iron is oxidised by being exposed to oxygen in the presence of moisture.

Although not obvious in dry air, rust’s odour can be detected in damp conditions, when oxidation is most likely to occur. Rust’s odour is carried in airborne water droplets, and this is how it is transmitted to our senses. Human blood, which also contains water and iron, has a smell similar to rust.

**David Muir**
*Edinburgh, UK*
This is an olfactory illusion. Smell the dry metal paper clip. Lick your fingers and give it a good rub, then smell it again.

Ferrous ions, Fe²⁺, form when skin touches the iron in rust, especially if skin is moist. These ions react with fatty compounds called lipid peroxides, present on your skin, to produce carbonyl compounds such as 1-octen-3-one. This has a smell we associate with your skin, to produce carbonyl radicals.

Researchers at the Virginia Polytechnic Institute and State University have shown that the amount of 1-octen-3-one increases in skin is rubbed with increasing concentrations of Fe²⁺ solutions.

Blood, containing Fe²⁺, also gives a metallic smell when smeared on our skin. This gives rise to the “coppery” odour of blood, but the smell is actually derived from the skin’s fatty chemicals.

**Luce Gilmore**
*Cambridge, UK*
While metals and metallic oxides are unlikely to have any odour, the same isn’t true of organic-acid salts of metals. This is what is responsible for the bitter smell of bronze coinage, for instance, on which copper forms salts with lactic acid from human sweat.

Radio gaga

If I use my cellphone then put it next to my bedside radio, the radio starts to make odd sounds through the speaker. What’s going on?

**Eric McAndrew**
*Capel, Western Australia*
Your cellphone is a radio transmitter. It periodically sends signals to the phone network to let the network know it is still there.

If the phone is near a radio, the signals, which are pulses of energy, penetrate the radio and you hear these as odd sounds. The only solution is to leave the cellphone and clock radio a few metres apart.

**Jens Ole Madsen**
*Neu-Ulm, Germany*
The sounds are electromagnetic disturbances induced in the audio system of the radio when the phone is transmitting. This isn’t limited to devices equipped with a radio receiver – the same sounds can be heard in an mp3 player close to a mobile phone. The frequency used by the phone doesn’t disturb radio reception, it just affects the audio lines of the device.

The most typical sound is generated during a location update. This is needed so the phone network knows which base station should contact the phone in case of an incoming call.

The complete location update, as defined in the Global System for Mobile communication (GSM) specification, consists of bursts of transmissions with set timings between them, and this gives a characteristic series of sounds.

Later mobile phone standards use a different form of location update, so you will hear this sound only when the phone is using the GSM network, usually because of lack of coverage on the 4G network.

What is the deposit found on clean windows after rain?

**Richard Hind**
*York, UK*
The same effect allows wireless charging of small electrical devices like toothbrushes. What you are hearing is the burst of phone signals at gigahertz frequencies being modified by the electronics in the radio.

Electromagnetic interference can be picked up from other devices, too, such as the motors in vacuum cleaners and power drills. Electric guitar players are all too familiar with this effect: if they stand next to any device with a conventional transformer there is a loud hum through the amplifier their guitar is plugged in to.

Computers are another source of electromagnetic interference because the processor is operating at gigahertz frequencies too. The power cable can act as an antenna. It is possible to use something called a ferrite choke to suppress this – that’s what the cylindrical object you often see on power cables for laptops is.

**John Childs**
*Durham, UK*
Radio manufacturers try to minimise sensitivity to “out of band” frequencies, but a strong signal can cause a response.

In analogue times, this sometimes resulted in hearing the actual audio content of radio chatter, often on public PA systems, which were sensitive to stray radio frequency emissions. Hearing what was being broadcast on taxi radios, for instance, wasn’t uncommon, and could be amusing or embarrassing depending on the words being said, although normally only the nearby signal was detected so one half of the conversation was missing.

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**This week’s new questions**

**Rainy residue** My windows are cleaned every four weeks, and normally stay sparkly. But recent heavy rain has left a deposit on them. What is it? Stuart Fairchild, Dunfermline, Fife, UK

**Viral survival** How long do viruses like cold, flu and coronavirus survive outside the body? What factors affect this? Douglas Fairchild, Two Harbors, Minnesota, US

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