

Discover Smart Materials

DISCOVER MATERIALS

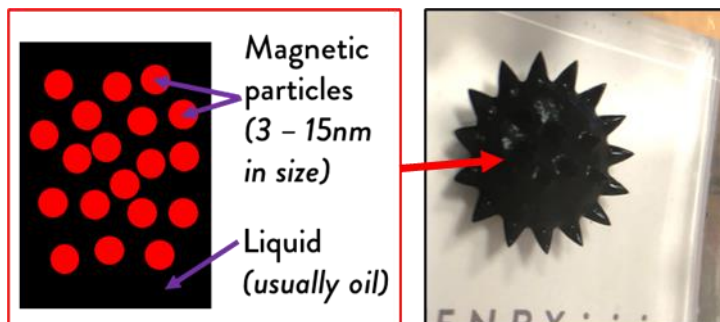
Ferrofluids

Small magnetic particles can line up with a magnetic field - you may have done an experiment using iron filings in a container (or even on top of a piece of paper).

Ferrofluids are tiny nanoparticles that contain iron and are suspended in a liquid (known as **colloidal suspension**). The nanoparticles in a ferrofluid are 3-15 nm* in size!

*1 nanometre (nm) = 0.000000001 m - one strand of hair is about 0.0001 m (0.1 mm) wide!

Because the particles in the suspension are so small the ferrofluid behaves just like a liquid and because the particles contain iron the fluid can be moved by using a magnet.



Ferrofluids were developed to move fuel around in spacecraft (where there is no gravity) but have also been studied for use in **medicine** and even as **liquid robots**!

Curriculum Links

- 'Core technical principles - Smart Materials' (AQA GCSE Design and Technology, Section 3.1)

Learn More

- Ferrofluids: <https://www.azom.com/article.aspx?ArticleID=6726>
- Ferrofluids as rocket fuel: <https://www.nasa.gov/feature/glenn/2021/history/novel-rocket-fuel-spawned-ferrofluid-industry> (NASA website)
- Ferrofluids an liquid robots: <https://www.newscientist.com/article/2338260-liquid-robot-can-split-into-tiny-droplets-and-reform-into-a-blob/> (New Scientist)
- Nanoparticles in medicine: <https://ferrofluid.ferrotec.com/applications/bio-medical/>

In Class Demonstrations

You can buy ready-made kits (essentially ferrofluid and alcohol in a glass jar)

In rectangular container



'Ferrofluid Venom' (incl. magnets) costs ~£15

(e.g. <https://tinyurl.com/2ekfb6x5>)



In cylindrical container



Each kit (incl. magnets) costs ~£15

(e.g. <https://tinyurl.com/5x39e6xm>)



What to do

- Hold one of the magnets next to the glass jar and watch spikes form (these spikes follow the magnetic field lines)
- If you have two magnets these can be held on opposite faces of the jar and be used to form bridges of ferrofluid inside the jar

!!Risks- There is a risk of the jar breaking and spilling its contents. If this happens clear it up immediately otherwise the spill will present a slip hazard and there will be sharp edge from the broken glass - and the ferrofluid will stain (due to the iron nanoparticles present)!!

Homework ideas

- Task the students with design a poster explaining what ferrofluids are and their current, and potential future, applications (you could use the links in the 'learn more' section).

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The future is what you make it, but it is also what you make it out of.