

Invisible writing

Safety:

- Be careful with the lemon, it is acidic - don't squeeze it into your eyes!
- Ask an adult to cut the lemon for you - you don't want to cut yourself.
- Ask an adult to iron the paper.

Apparatus:

- Half a lemon
- Water
- Spoon
- Bowl
- Cotton bud
- White paper
- Iron (best) or other source of heat



Method:

Summary:

Have you ever wanted to keep secret messages hidden away from others and feel like a secret agent? This activity will enable you to do so and learn some science whilst at it.

Steps:

1. Cut a lemon into two halves and squeeze the lemon juice.
2. Put the lemon juice in a container.
3. Take a cotton bud and dip it into the juice.
4. Write whatever it is you want to write on white paper (make sure that you don't apply too much pressure so that the paper does not become waterlogged).
5. Wait for the juice to be dry, so that it is completely invisible.
6. When you are ready and want to reveal the secret message, simply heat the paper by holding it next to a bulb (or this works better but need to ask parents: use an iron).

Watch this video here, if you want a walkthrough of the experiment:
<https://youtu.be/elNYAvVjbac>

Evaluation / Conclusion

Can you make shapes or drawings instead of just letters?

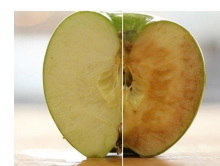
What would happen if you used more lemon? What about less?

Do you think it would work with a lime? What about completely different fruits such as apples? Why not give it a try?

FOLLOW UP SCIENCE

There are different ways to make invisible ink. However, this is the easiest. You can use an Ultraviolet light - which is a special type of light. However not many people have UV lights hanging around! In this follow up section, we will talk about science from physics and chemistry, because in this experiment, it's all in action!

The chemistry involved behind this “magic” experiment, the process that took place to turn the lemon juice brown, was “oxidation” which just means that something gained oxygen. When you painted the lemon juice onto the paper, its compounds were absorbed by the paper. Later, with the heat, these compounds were oxidised and this meant that a brown colour appeared on the paper. Another reason behind the darker colour that you saw was the fact that the lemon juice is an acid. Essentially, the juice changed the chemical makeup of the paper and therefore made it more likely for it to blacken and char. However, oxidation does not necessarily require heat as you may think from this experiment - for example think of the brown apple slices you can find in fields on the ground - this is oxidation in action and is key to so many processes everywhere around you.



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As mentioned above, this experiment can also be carried out using UV light. But what is UV light? Well, in physics, there is something called the ‘Electromagnetic Spectrum’, which sounds mysterious but is really quite simple. It is a type of energy transfer which is very common, and it’s happening all the time! All the sunlight coming from the Sun, travels through space to Earth as part of this ‘EM Spectrum’. Basically the ‘EM Spectrum’ is made up of multiple types of waves and you may have heard some of their names: gamma rays, UV light, microwaves, radio waves etc... However, we can’t see those waves except for the visible part of the spectrum (as can be seen from the diagram). So this is what UV light is: it is just one of the 8 waves that make up the Electromagnetic Spectrum. UV rays are the same ones that give you sunburn!

