Prof Otto Lührs with his daughter Elena in his lab in the cellar

Otto Lührs, *Physicist*

What would have happened if Otto Lührs' father had not had a telephone?

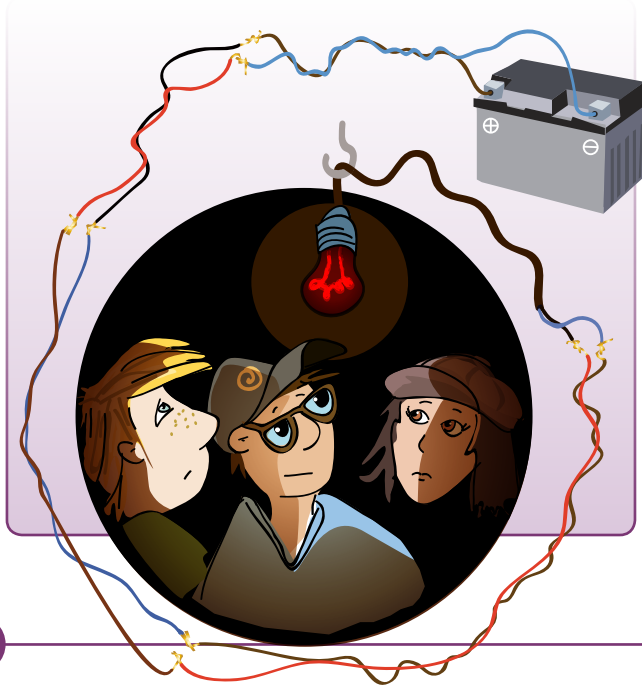
My name is Elena. My father, Otto Lührs, is an electrician, a physicist and an artist. As an electrician he learned to lay cables. As a physicist, he was fascinated most of all by how the eye perceives objects, how the brain processes these impressions, and how we are sometimes fooled by these impressions. I'll talk more about that later. My father built devices to illustrate these themes, and he showed them in exhibitions, like an artist. Now I'll tell you how all this happened.

My father was born in 1939 and grew up on a farm in Lower Saxony. When he was about nine years old, he collected wires and cables that other people no longer needed. Together with his friends, he had dug out a cave, and he wanted to have a light in it. He connected the cables, which had a light bulb hanging from them, to my grandfather's motorcycle battery. But the light bulb didn't shine – it only put out a dim glow. My father and his friends were fairly disappointed. Only much later did they find out why their homemade lighting system couldn't work.

When Papa was a boy, he often watched his uncle Johann, who was very interested in technology. Johann was always trying to improve his reception of distant radio stations. He stretched wires between the house and a cherry tree to form a homemade antenna. The reception was sometimes better and sometimes worse.

As an electrician, my father learned how radios, televisions and telephones work

When my father was a young man, he did an apprenticeship as an electrician – specifically, as an electrical installer. Among other things, he learned what he hadn't known when he had tried to light up the cave he had dug out with his friends. The old cable he had used back then, which was about 100 metres long, used up so much energy itself that there was very little energy left for the light bulb.



Otto Lührs, about nine years old

Most of all, my father liked learning about radio, television and telephone technology. After he finished his apprenticeship, he moved to Bremen and worked for the Post Office, which at that time was still responsible for the telephone wires. A new city neighbourhood was being built, and Papa and his colleagues laid new telephone wires. Back then he never wanted to own his own telephone. He thought he would never use it, because there were public telephones all over the city and he could always use those. People seldom used the telephone in those days.

My father wanted to learn even more, so after work he went to evening classes in Bremen and completed his A-levels there. Not long after that, he was on a visit to my grandparents out in the country. While he was there, he got a phone call from his friends. Papa still didn't have his own telephone, but his father had one because he was something like the mayor. Papa's friends invited him to come with them to Berlin. He agreed, his friends picked him up in a car and they all drove to Berlin. That trip changed his life.

Papa built his first physics artwork with light-emitting diodes

Papa ended up studying electrical engineering in Berlin. He thought this was a good way to continue what he had been doing until then. Later he changed his field of study to physics. He also tinkered with physical phenomena in his free time. He began to do experiments with light-emitting diodes, which are known as LEDs for short. An LED is a small modern lamp that consumes very little electricity but is very bright.

Papa took a music record, drilled tiny holes into it and put a lot of tiny coloured LEDs on it. He connected the record to an electric wire from below and turned it – slowly at first, then faster and faster. When he turned the record slowly, he could see the individual LEDs, but when he turned it fast, big circles appeared on the record and the individual LEDs could no longer be seen. This is because when the LEDs move, they leave a trail of light behind them. If the next LED follows close behind, we cannot distinguish the LED from the trail of light, because our brains put together what we are seeing into a continuous circular line. Our eyes and our brain seem to be playing a trick on us.

My father became the director of the first "hands-on" science museum in Germany

But let's get back to my father. When he finished studying, Papa did further training as a cultural worker. He had already made several devices that he could display in art exhibitions. Artworks made of technical components were considered very modern in those days.

At that point he got a job in which he could combine his interest in technology and his interest in art. At the Museum of Technology in Berlin he organized an exhibition that later became Spectrum, the first Science Center in Germany. It's a kind of museum where you can try out the experiments for yourself. Go and see it the next time you're in Berlin!

Papa built many exhibits that help people get to know physical phenomena, and visitors to Spectrum are still using them today. Are you getting curious? If you are, you can make your own exhibit, a "disc rotography". It's described on the following pages. You'll be astonished by what you see. Have fun!

Now it's your turn!

1 Building a disc rotography

"Rotography" was my father's name for his experiment with the light-emitting diodes on the record. He often presented it in a similar form in exhibitions. You can also put together a rotography experiment!

What you need: (Tips on materials on page 45)

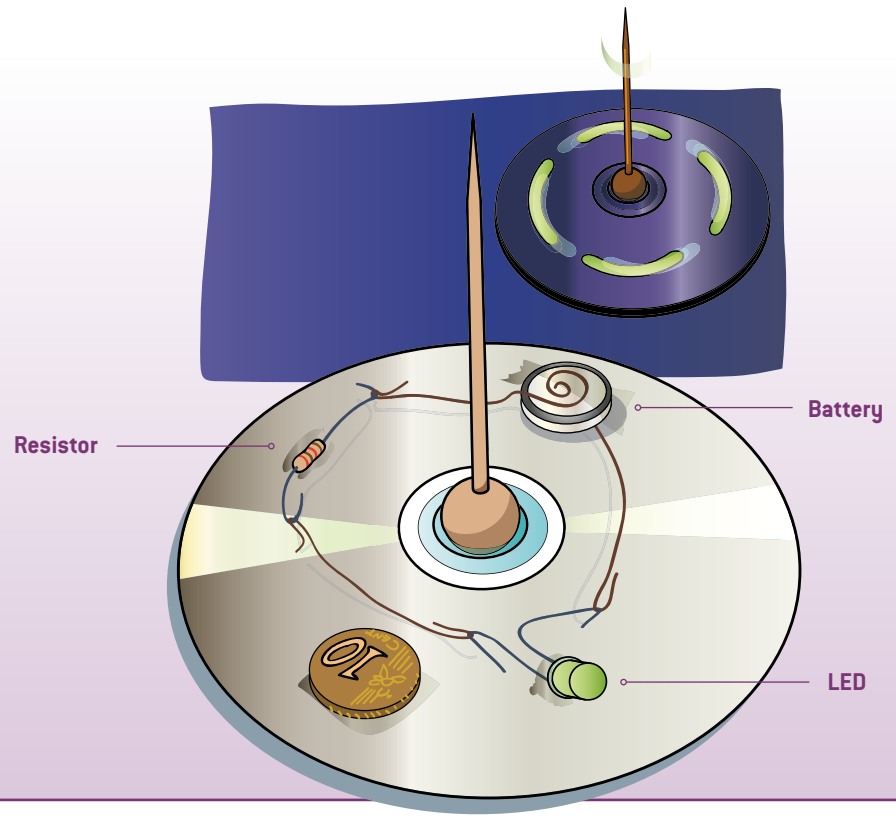
- 1 disc (for example, a blank CD)
- 1 light-emitting diode (LED)
- 1 battery
- 1 resistor
- 1 wooden ball with a hole drilled in it
- 1 toothpick
- 2 short wires (about 8 centimetres long)
- 1 longer wire (about 18 centimetres long)
- 1 coin to balance the battery
- Double-sided stickers
- Sticky tape
- Glue, scissors and a ruler

How to build the disc rotography experiment:

- Put the toothpick into the drilled hole of the wooden ball and glue the wooden ball into the hole of the disc with fast-acting glue, so that the toothpick is standing straight up. This will work best if you first lay the CD on a cup.

- When everything has dried, stick a double-sided sticky pad onto the disc and stick the coiled end of the long wire on top of it. Press the battery on top of the wire. Fasten one of the short wires to the top side of the battery with a piece of tape.

- Now bend the wires of the resistor slightly upwards and glue the resistor to the disc. After the glue dries, you can connect the short wire that is stuck to the battery to the resistor. Fasten the other short wire, which you have not yet glued to anything, to the free end of the resistor.



- Before you glue the LED to the disc, you have to test it. Bend its wires upwards. Hold one wire to the wire coming from the battery and the other end to the wire coming from the resistor. If the LED lights up, glue it to the disc in this position. If it does not light up, simply swap the wires around and then glue it to the disc.

- **Note:** Make sure the wires don't touch each other. If you do, there will be a short-circuit.

- Now take the coin and use a double-sided sticky pad to fasten it to the place on the disc where it will balance the battery. Now switch off the lights and turn the disc!

2 Questions about the text

- Find information about the profession "electronics engineer"
- Find out what kind of work a physicist does.
- What is a light-emitting diode?
- Think about what it would be like to live without a telephone or a mobile phone, and describe it to the class!

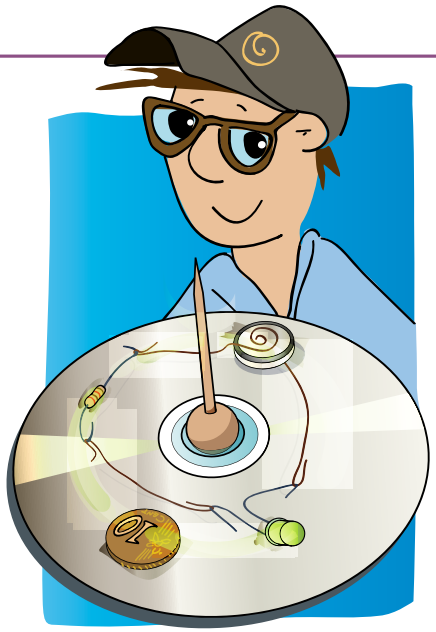
This model W48 telephone was the standard telephone of the German Post Office from 1948 until about 1970. What do you notice about it?

Resistance in the electrical circuit?

The disc rotography you have built is an electrical circuit. The battery generates electricity that flows through the LED and makes it shine. But without one more component, the electric current would be so strong that it would destroy the LED. The resistor keeps the strength of the current to a level that keeps the diode whole.

3 Pupil experiment

Look directly into the eyes of a classmate. In the middle of each eye you will see a black point, the pupil. Note the size of the pupils. Now ask your classmate to look out of the window or at a brighter part of the room. How do the pupils react? Describe this reaction.



Otto Lührs – Physicist

Otto Lührs was born in 1939.
He grew up on a farm in Lower Saxony.
When he was a child, he collected wires and cables.
He dug out a cave with his friends.
They wanted to have light in the cave.
Otto Lührs put together many small pieces of cable and laid a power line.
But the light bulb did not burn brightly – it only put out a dim glow.
Why?

Otto Lührs became an electrician.
He found out that many small cables use up too much energy.
That's why the light bulb did not burn brightly.
Otto Lührs was interested in radio, television and telephones.
He wanted to learn even more.
He got his A-levels certificate and studied electrical engineering and physics in Berlin.

He liked to do experiments with LEDs.
He fastened LEDs to a record.
He spun the record – first slowly, then fast.
The separate points of light became trails of light.
He built many devices like this one and displayed them in art exhibitions.
Later he was the head of the first "hands-on" science museum in Germany – the Spectrum in Berlin.

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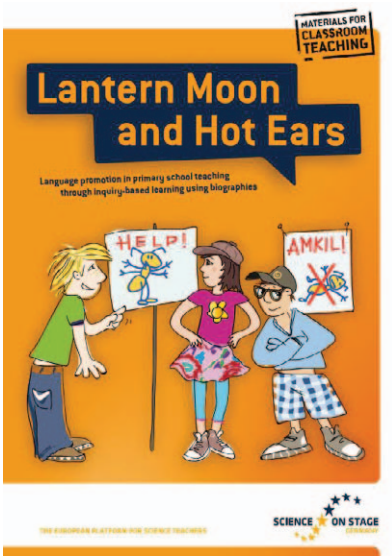

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