STEAM Tales

Lesson plans

Asta Hampe

MIND gGmbH Mittelhessisches Institut für Nachhaltigkeit und Diversität
GoINNO
U.PORTO
cesie the world is only one creature
LogoPsyCom

Co-funded by the European Union

Asta Hampe's biography

University of Hamburg (1935). *Asta Hampe - Engineer.* In Wikimedia Commons. Asta Hampe 1935 Source: DAB - https://www.uni-hamburg.de/en/gleichstellung/gender/frauenportraits.html

Asta Hampe was born in 1907 in Helmstedt, Germany, in a family that owned a wool spinning mill business. As she was often surrounded by technical work, she developed a fascination with machines and dreamed of studying engineering, even though societal expectations limited women to traditional roles. As an adult, with the support of her family, she pursued her passion and became an accomplished engineer, physicist, and economist. She contributed significantly to radio and radar technology, worked as a physicist during World War II, and later became a professor and shaped the field of economic statistics. Although Asta faced gender discrimination and political persecution, her perseverance led to remarkable achievements. She was a pioneer in advocating for gender equality in STEM fields, which inspired many people and opened opportunities for women in academia.

Co-funded by the European Union

Lesson plan 1

Exploring static electricity with a balloon Keywords: Static electricity, attraction, repulsion, electrical charge	
Duration: 60 min	**Age:** from 6 to 9 years old
Place: Classroom	**Related STEAM areas:** **S** (Science): Behaviour of static electricity and how it causes objects to attract or repel each other. **E** (Engineering): Principles used in telecommunications engineering, such as electrical charge manipulation in devices.
Description	In this experiment, children will explore the properties of static electricity using a balloon and various materials. They will also discover how static electricity causes objects to attract or repel each other and why that happens.
Learning objectives	At the end of this experiment, children will be able to: • Explain, in their own words, how friction generates static electricity.

	• Perform a simple demonstration showing how static electricity causes materials to attract or repel each other. • Identify at least two objects that respond to static electricity.
Connection to the female role model	This experiment connects to Asta Hampe's work in telecommunications engineering, where understanding and controlling electrical charges are essential. Hampe's research in radio and radar technology depended on manipulating electrical charges, which, in theory, is much like the static electricity observed in this experiment.
Individual or group	This is a group activity where each child will have their own balloon to test individually.
Safety	There are no major safety concerns with this experiment. However, the teacher should supervise any cutting of paper with scissors. Additionally, some children may need assistance with blowing up and tying the balloons.
Materials	☐ Balloons (one for each child) ☐ 1 scissor ☐ 2 sheets of paper A4 (more if possible) ☐ 2 empty aluminium cans (more if possible)

	☐ 10 pieces of foam packaging peanuts (more if possible) ☐ 5 metal coins (more if possible) ☐ 5 glass marbles (more if possible)
Lesson plan	
Introduction (10 min)	Begin with a question to spark the children's curiosity: "Have you ever felt a little zap when you touch something after walking on a carpet? Or seen your hair stand up when you pull off a sweater?" That's called static electricity! This experiment will allow us to create static electricity using a balloon to explore how it can attract or repel objects. Briefly refresh Asta Hampe's work by mentioning she was an engineer who knew how to control electricity so that it could be used for telecommunications through radios and radar systems.
Research question/hypothesis (5 min)	Ask: "What do you think will happen when we rub a balloon on our hair and bring it close to other objects?". Encourage students to guess what they think will happen when they bring the balloon close to objects like paper, aluminium cans, glass marbles, etc.

Step-by-step instructions (30 min)	**Step 1 – Organise Group Stations:** Divide the class into five groups and assign a different table for each group. **Step 2 – Prepare Materials for Each Table:** Cut sheets of paper into small pieces (2-3 cm). Place one type of material at the centre of each table: one table with paper pieces, one with empty aluminium cans, one with foam peanuts, one with metal coins, and one with glass marbles. **Step 3 – Distribute Balloons:** Give each child a balloon. Ask them to slightly inflate them and tie them. Provide assistance if needed. Each child should have a balloon. **Step 4 – Charge and Test Balloons:** Have each child rub their balloon on their hair to create static electricity. Then, ask them to bring it near the objects on the table and to observe what happens. **Step 5 – Rotate and Repeat:** Rotate each group to the next table, allowing them to test their charged balloons on a new set of materials.

	Remind that the balloon should be rubbed on the hair every time they go to the next table to make sure it is charged. Repeat until each group has experimented with all five objects.
Source	"5 Awesome Static Electricity Experiments for Kids" by TheDadLAb "11 EASY SCIENCE EXPERIMENTS TO DO AT HOME / STATIC ELECTRICITY" by Fun Science
Conclusion (5 min)	Ask the children what happened when they rubbed the balloon when they brought it close to the different objects. They should notice that some objects, like the pieces of paper, the foam peanuts and aluminium cans, were attracted to the balloon, while others, like metal coins or glass marbles, didn't move at all. Ask them why they think that happened: "Was it because of their shape? Their weight? Or was there some invisible energy involved?" Explain that rubbing the balloon created static electricity, a force that allows objects to attract each other without touching. This is because the balloon became charged and interacted with certain objects nearby.

Explain the experiment (5 min)	When the children rub a balloon in their hair, tiny particles called electrons move from their hair to the balloon. This gives the balloon a negative charge because now it has extra electrons. Now, when the balloon is brought near a piece of paper, the balloon's negative charge pushes the electrons in the paper away, which makes the part of the paper that is closest to the balloon positively charged. Opposites attract, so the balloon and the paper pull toward each other! This attraction doesn't happen with all objects, only those that respond to the static charge, which is why objects like metal coins and glass marbles did not move.
The science behind	Static electricity happens when electrons (tiny negatively charged particles) move from one object to another due to friction. In this experiment, rubbing the balloon on hair causes electrons to transfer from the hair to the balloon. As a result, the balloon becomes negatively charged (while the hair becomes positively charged since it lost electrons). When the negatively charged balloon is brought near an object that hasn't been charged, i.e. a neutral

	object (like a piece of paper or an aluminium can), the balloon's negative charge pushes some of the electrons in the object away. Temporarily, this creates a positive charge on the side of the object closest to the balloon (while the farthest side of the object becomes negatively charged). Since opposite charges attract, the object is attracted towards the balloon. However, not all objects respond to the charged balloon in the same way. Conductive materials (like metals) and polar materials (like water) can show attraction to a charged object. On the other hand, insulated materials (like wood or glass) don't allow their electrons to move as freely as conductive materials. But being a conductive material alone isn't enough to make an object move. For example, although an empty aluminium can that is made of metal was attracted to the balloon, the metal coin was not. The reason is that the aluminium can is light and has a shape that allows it to roll easily, while the metal coin is heavier and flat, so it's harder for the attraction to visibly move it. So, not only does it depend on the type of material, but also on its weight and shape.

	This concept of charge transfer and attraction is central to many modern technologies, including telecommunications. Asta Hampe’s contributions to radio and telecommunications engineering used these same principles to manipulate electrical charges, which allowed to send and receive signals wirelessly. By understanding and controlling the movement of electrons, Hampe and engineers like her advanced communication technologies, applying the fundamental laws of static electricity.

Lesson plan 2

Building an Electromagnet Keywords: Electromagnetism, magnetic fields, simple circuits	
Duration: 70 min	**Age**: from 7 to 9 years old
Place: Classroom	**Related STEAM areas:** **S** (Science): Exploring the relationship between electricity and magnetism, and understanding how an electric current generates a magnetic field. **E** (Engineering): Constructing a functional electromagnet and analysing how design choices, like the number of wire loops, impact its strength. **M** (Maths): Counting and comparing the number of wire loops to observe how increasing the coils affects the electromagnet's strength.
Description	In this experiment, children will create an electromagnet. They will observe how the nail becomes magnetic when current flows through the wire and loses its magnetism when disconnected. This

	demonstrates the principles of electromagnetism and how it is used in real-world applications.
Learning objectives	At the end of this experiment, children will be able to: • Construct an electromagnet using copper wire, an iron nail, and a battery. • Explain how electric current creates a magnetic field. • Demonstrate the difference in magnetic strength based on the number of wire loops. • Provide examples of how electromagnets are used in real-world devices (such as motors and cranes).
Connection to the female role model	This experiment connects to Asta Hampe, a pioneer in telecommunications engineering. Hampe applied the principles of electromagnetism to develop technologies for transmitting and receiving signals, such as radios and radar systems. Her work demonstrated the practical power of electromagnetism in long-distance communication. By creating and testing electromagnets, children engage with concepts that were essential to her innovations in engineering and technology.

Individual or group	Group activity: Divide students into at least 2 different groups. Each group will work together to build their electromagnet.
Safety	There are no major safety concerns. Nevertheless, the children should be supervised since when the wires are connected to the battery, the ends must not touch each other to prevent battery damage and short circuits.
Materials	This is a group activity and the list below includes the materials needed to create at least 2 electromagnets (for 2 groups of children). If possible, prepare more sets of material to ensure that everyone can participate. ☐ 2 Iron nails (about 5-10 cm long; must be iron or a ferrous metal) ☐ 1 copper wire (about 1 meter long; 26-30 gauge works well) ☐ 2 AA or AAA batteries. ☐ Paperclips (10-15 per group) or small metal objects to test the electromagnet ☐ Adhesive tape (or electrical tape) ☐ Sandpaper (or wire strippers)

Lesson plan	
Introduction (10 min)	Start by engaging the children with a question: "Have you ever seen a crane lifting cars at a junkyard or wondered how electric motors work in toys?" Explain that many devices, from cranes to electric motors, rely on something called an electromagnet. Electromagnets are magnets that can be turned on and off with electricity. The current experiment will allow them to create their own electromagnet and explore how it works by lifting small objects like paperclips.
Research question/hypothesis (5 min)	Pose questions to stimulate curiosity and predictions. For instance: • "What will happen to the nail when you wrap a wire around it and connect it to a battery?" • "Do you think the number of wire loops around the nail will affect how strong the magnet is?" Encourage children to share their guesses. Record their predictions to revisit during the conclusion.
Step-by-step instructions (40 min)	**Step 1: Preparing the materials** Start by cutting the copper wire into two pieces in a 2:1 length ratio, i.e., one piece should be twice as big

	as the other. One simple way to do it is to fold the wire into three equal parts and cut off one part. **Step 2: Dividing the class into groups** Make at least two groups (or small groups of four). Give each group one piece of copper wire (one gets the shorter piece, and the other gets the longer piece) along with an iron nail, one battery, and sandpaper. Show children how they can use sandpaper (or wire strippers) to carefully strip about two centimetres of insulation from each end of the wire. **Step 3: Wrapping the nail** Ask the groups to tightly wrap the copper wire around the iron nail in a spiral way and to leave about two centimetres of wire free at both ends so that it can be later connected to the batteries. **Step 4: Recording the loop count** Since the group with the longer wire will be able to do nearly as twice as many loops around the wire. ask children from each group to keep track of how many loops they wrapped the wire around the loop. This

	difference in loops will allow to compare the difference in strength of both electromagnets later on. **Step 5: Connecting to the battery** Have each group attach the free wire ends to the positive and negative terminals of the battery. Tell them to add a small piece of tape just enough to hold the wire in each terminal (to make it easier to remove it later). **Step 6: Avoiding short circuits** Tell the children to make sure that, while the wire is taped to the batteries, the ends do not touch each other or it could cause a short circuit. **Step 7: Test the electromagnets** Invite each group at a time to bring their electromagnet close to the paperclips and count how many they can pick up at once. **Step 8: Observing magnetism loss** Afterward, have them disconnect one wire end from the battery and observe that the paperclips

	immediately fall away since the nail loses its magnetism without current.
Source	“How to make an electromagnet – Kid Science Experiment you can do at home or science fair project” by JoJO's Science Show – Kids Science
Conclusion (5 min)	After the experiment, gather the children to discuss what they noticed. Ask questions like, “What happened when the battery was disconnected?” and “Why do you think the nail that had a longer wire was able to pick up more paperclips?”. Explain that the higher number of coils produces a stronger magnetic force. Moreover, explain that the magnetism disappears once the current is interrupted because the nail is not a permanent magnet, which is why the paperclips were no longer attracted to the coil when the battery was disconnected. This discussion will help them better understand how and why the nail could pick up paperclips, yet return to a normal nail when the circuit was broken.
Explain the experiment (5 min)	The nail becomes a magnet only when connected to the battery because electricity flows through the wire and creates a magnetic field. As soon as this

	temporary magnet is disconnected from the battery, the field goes away, and the nail loses its magnetism. This is why it is called an electromagnet – it needs electricity to work! The strength of an electromagnet can be increased in different ways. One of the most effective ways, as observed by children in this experiment, is to increase the number of wire loops around the coil because each loop adds to the magnetic field. In other words, the more loops of wire, the stronger the magnetic field that is generated. This is why the group with the longer wire and more loops was able to lift more paperclips. Another way to enhance the strength of an electromagnet is by using a stronger battery or power source, which provides a greater electric current to produce a more powerful magnetic effect. Additionally, using a larger ferrous core with high magnetic permeability allows the magnetic field to concentrate more effectively, further increasing the electromagnet's strength.

	Explain that electromagnets are used in many everyday devices. Cranes in junkyards lift heavy cars with large electromagnets, while small electric motors in toys also rely on this principle to convert electricity into motion. They all rely on the same idea of switching a magnet on and off with electricity.
The science behind	Electromagnetism is the combined force of electricity and magnetism. When an electric current flows through a wire, it generates a circular magnetic field around that wire. By coiling the wire and inserting a piece of iron at its center, the magnetic field intensifies, producing a stronger magnet. However, since this magnet depends on the flow of electricity, it remains active only as long as the circuit is complete. The moment you disconnect the battery, the current stops, and so does the magnetic effect. This temporary nature of electromagnets allows them to be turned on or off as needed, which is extremely useful in technology and industry. **Historical Context**: The principles of electromagnetism were first explored by pioneering scientists such as Hans Christian Ørsted who discovered the relationship between electricity and magnetism

	and Michael Faraday who further developed the concept of electromagnetic induction. Their groundbreaking work laid the foundation for modern technologies that heavily rely on electromagnetism, such as electric motors, loudspeakers, and MRI machines. In the field of telecommunications, engineers like Asta Hampe and other pioneering female scientists applied these principles to transmit signals across great distances, contributing significantly to advancements in communication technology.

#steamtales–project

www.steamtales.eu

Co-funded by
the European Union

STEAM Tales (KA220-HE-23-24-161399) is funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the Nationalen Agentur im Pädagogischen Austauschdienst. Neither the European Union nor the granting authority can be held responsible for this.

MIND gGmbH Mittelhessisches Institut für Nachhaltigkeit und Diversität

GoINNO

U.PORTO

cesie — the world is only one creature

LogoPsyCom