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Handbook for primary school STEM teachers "How to implement advanced ICT-based educational approach in STEM school subjects"

Intellectual product 1

Project tittle: Establishing of the innovative ICT-based educational

Approach for tackling of students' academic

underachievement in STEM related school subjects in primary schools

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CONTENT :

Introduction

Despite significant technological advancements, many STEM topics in primary school continue to be

presented through static textbook images, leaving teachers with the difficult task of sparking curiosity and understanding among students with limited visual and interactive support. This challenge is especially pronounced when students first encounter complex concepts in subjects like physics, chemistry, biology, and upper-level mathematics.

The project behind this Handbook recognizes the gap in academic achievement between STEM and non-STEM subjects among students aged 10 to 12 in countries like North Macedonia, Spain, and Bulgaria. Research shows average grades in STEM subjects fall significantly below those in social subjects, with more than 80% of failing test scores originating from STEM-related areas.

Addressing this challenge requires more than just access to new technologies. While hologram projectors and VR/AR tools are now more affordable than ever, their effective implementation depends on the presence of well-trained, motivated teachers using suitable pedagogical approaches.

This Handbook aims to bridge that gap by introducing an advanced ICT-based educational concept tailored for primary STEM education. It promotes "learning by doing" through problem-based tasks, research teamwork, and immersive technology. By integrating holograms and VR into everyday lessons, STEM subjects can become more tangible, accessible, and inspiring for all students, regardless of gender or background.

The following chapters offer a comprehensive guide for teachers on the pedagogical and technical aspects of using holograms and VR in classrooms, as well as practical lesson plans for immediate implementation.

Chapter 1: Description of the Main Aspects of the Advanced ICT-Based Educational Approaches

1.1. Understanding academic underachievement in STEM

Low academic achievement in Science, Technology, Engineering and Mathematics (STEM) disciplines is a complex problem influenced by a variety of factors, including teaching methodology, student motivation, teacher preparation, and the availability of resources.

There is concern about the decline in the choice of technological branches in higher education, largely attributed to the perceived difficulty in understanding the content.

Students have reported low motivation, difficulty in maintaining attention, a lack of understanding of theoretical content and a disconnect between what they are studying and the real world. These traditional teaching methods are questioned for their low long-term effectiveness in achieving meaningful and lasting learning.

The integration of Information and Communication Technologies (ICT), especially Augmented Reality (AR) and Virtual Reality (VR), within active pedagogical methodologies such as Problem-Based Learning (PBL) and the STEM approach, together with work in heterogeneous cooperative teams, can address this underperformance.

Factors contributing to underachievement in STEM:

- Abstract nature of concepts: Technology subjects often involve complex concepts that students have difficulty visualizing or connecting to reality.
- Low motivation and loss of attention: Students may show little interest and become easily distracted during technology classes.
- Lack of linkage to the real world: Students often do not perceive the practical application of technology content in their environment.
- Ineffective traditional teaching methods: Passive methods may not foster meaningful and lasting learning.
- Beliefs and attitudes: Gender and socioeconomic background may influence the likelihood of pursuing STEM. Boys tend to show more disposition toward math-related professions, and students from disadvantaged backgrounds are less likely to pursue studies in science and mathematics.

How advanced ICT-based educational approaches can help:

- **Experiential learning and concept manipulation**: AR enables manipulation of abstract concepts and experimentation with content in a more dynamic and motivating way. For example, designing AR activities to recreate machines in 3D and interact with virtual models, facilitating the understanding of practical concepts. VR can transport students to virtual environments, such as a microscopic journey inside a cell, making learning less abstract.
- **Active methodologies**: ICT integration is effectively realized when combined with active methodologies such as PBL, where learning is focused on solving relevant problems. STEM methodology seeks to integrate Science, Technology, Engineering and Mathematics in a practical way, and AR can be an effective tool in this context.
- **Cooperative teamwork**: Heterogeneous cooperative teamwork is enhanced with ICT, facilitating collaboration and knowledge sharing. Increased motivation and attention: AR has proven to be an effective tool for improving student motivation and attention towards technological subjects. The ability to experiment close to reality is key to experience-based learning.
- **Overcoming practical limitations:** AR can compensate for deficiencies present in education, such as the high costs of equipment needed for experiments, limited availability of facilities, and conducting complex and dangerous experiments.

- **Development of cross-cutting skills**: AR has characteristics that are ideal for the enhancement of cross-cutting skills in technology education, such as improving spatial vision and problem solving.

It is essential to emphasize that simply adopting technology is not enough. The key lies in careful pedagogical planning that integrates ICTs in a meaningful way into learning activities, considering educational objectives and students' needs. In addition, teacher training in the pedagogical use of ICT and active methodologies is crucial. AR and other ICTs should be understood as tools to help create content that promotes better learning, and not as an end in themselves.

Finally, it is important to keep in mind that adequate and unbiased evidence on the impact of educational technology is not abundant. Therefore, decisions about educational technology should be evidence-based and consider the specific context.

1.2. Pedagogical foundations: learning by doing, inquiry-based learning, and collaborative work.

The pedagogical approaches of learning-by-doing, inquiry-based learning and collaborative work are central to advanced ICT-based educational approaches, particularly in the integration of Augmented Reality (AR) and Virtual Reality (VR) to address academic underachievement.

- **Learning by doing:**

The educational application of AR and VR is aligned with a constructivist pedagogical approach oriented to active learning ("learning by doing"), where students decide how to combine augmented information or interact with the virtual simulation. The student's relationship with the learning object is not based only on the consultation of intellectual content, but involves an immersive experience in the learning environment.

It is recommended to motivate learning by doing when implementing AR and VR in the classroom.

AR activities for the technology subject are based on the development of a project created by the students themselves as a means of direct experimentation to ensure deeper learning.

Both AR and VR facilitate the practical experimentation of theory, allowing students to test what they have learned, interact with the learning object, generate alternatives, visualize objects from different perspectives and intensify the relationship between theory and practical application.

- **Inquiry-based learning (Inquiry-based learning):**

AR activities rely on discovery learning and heterogeneous cooperative teams, using ABP (Problem-Based Learning) and STEM methodologies.

Constructivism, which is a key pedagogical basis for the AR activity, focuses on learning by discovery and experimentation.

Both AR and VR enable scenarios in which the learner can test the learned theory in different ways, exploring the conditions under which it does or does not apply.

- **Collaborative work:**

Activities with AR are developed through project work in heterogeneous cooperative groups. The work in heterogeneous cooperative teams is a key success factor integrated in the design of the activity.

AR activities have to be designed to foster cooperative learning, including key ingredients to ensure task sharing and collaboration to achieve the final goal.

Collaborative digital tools can enhance the diversity and quality of content creation.

Collaborative activities based on VR and AR provide students with the opportunity to work as a team towards a common goal, allowing the co-evaluation of their contributions.

The student experiences active, visual and teamwork learning where, in addition to acquiring knowledge of the subject matter, he/she develops leadership, critical thinking, problem solving and collaborative work skills.

The creation of learning objects in augmented reality format favors the implementation of the project-based methodology and enhances collaborative learning.

Collaborative activities contribute to the construction of knowledge based on teamwork when AR and VR are used.

These pedagogical approaches, enhanced by the immersive and interactive capabilities of AR and VR, seek to transform the learning experience, making it more active, relevant and meaningful for students, which is considered crucial to address academic underachievement in STEM and other areas.

1.3. Integrating ICT to enhance concept visualization and student engagement

The integration of Information and Communication Technologies (ICT), especially Augmented Reality (AR) and Virtual Reality (VR), is proposed as an effective strategy to enhance visualization of concepts and increase student engagement.

The use of digital technology over the past 40 years has great potential to transform education, and an educational technology industry has developed that includes AR and VR. These technologies are expected to be key to the future of education, with exponential growth in the coming years.

- **Improved visualization of concepts:**

AR allows the manipulation of abstract concepts and experimentation with content in a more dynamic and motivating way. It is proposed as an effective tool to improve the understanding of theoretical content.

Activities on an object facilitate its capture and cognitive interpretation, and accessing an object from multiple perspectives favors the construction of meanings for the student. AR enables contextualization of information and cognitive organization by the learner by combining virtual data with the real world, creating a multimedia environment.

VR can move students into virtual environments, making learning less abstract and more experiential. One example is the use of VR to visualize animal and plant cells, allowing students to explore their components and structures at a microscopic level.

AR, through “magic books,” can enable the visualization of aggregated 3D information through a digital device, evolving from traditional literacy materials.

In engineering, AR has been used to project three-dimensional models that students can manipulate, enhancing their spatial thinking. It is also used to complement learning units with three-dimensional models of industrial systems, clarifying knowledge and generating interest.

- **Increased student engagement**:

AR has proven to be effective in improving student motivation and attention to technology subjects. The ability to experiment close to reality is key to experiential learning.

The novelty of AR and VR generates curiosity and appeals to generations that have grown up with digital technology. Students express that this type of educational technology facilitates and motivates learning.

AR allows experimentation without leaving the classroom and replicating situations that could not occur without virtual support.

The implementation of AR and VR can be based on pedagogical principles that encourage active and experiential learning. The student experiences active, visual, and often team-based learning.

The design of AR activities can follow video game theory, placing students in an immersive environment with digital narratives to acquire specific concepts that they can then transfer to the real world.

Integrating AR into projects where students must collect and evaluate information and select multimedia resources to display generates innovative and engaging interaction.

It is crucial to note that the effectiveness of ICT integration, including AR and VR, depends on careful pedagogical planning and not making the mistake of using technology for its own sake. Technological resources should be part of an activity whose design is the responsibility of the educator. In addition, it is recommended to motivate learning by doing when implementing AR and VR in the classroom. Activities should be designed so that the student can interact and be part of the narrative, verifying that they interact easily with complex information and encouraging social relationships among students.

The effective integration of ICT, particularly AR and VR, requires a profound transformation in teaching and learning practices, exploring emerging pedagogies that take advantage of their full communicative, informative, collaborative, interactive, creative and innovative potential.

1.4. Addressing gender bias and stereotypes in STEM fields

Addressing gender bias and stereotypes in STEM (science, technology, engineering, and mathematics) fields is crucial to fostering equity in education and career opportunities

According to UNESCO's Global Education Monitoring Report 2023 Summary, gender is one of the strongest determinants of the likelihood of pursuing studies and careers in STEM fields. In 2016-2018, **only 35% of higher graduates in STEM fields were women**. Furthermore, research conducted in 2019 revealed that 8th grade boys were more likely to pursue a mathematics-related career than their female classmates in 87% of the education systems analysed. These data underscore the persistence of a gender gap in aspirations and representation in STEM from an early age.

The report also suggests some strategies to address this problem. It mentions that some countries are introducing STEM before beliefs about the role of men and women are settled. An example of this is the Little Scientists project, created in Germany, which promotes STEM learning among pre-primary students and has also been implemented in Thailand. This initiative seeks to spark interest and develop STEM skills at an early stage, potentially before gender stereotypes have a significant impact on students' choices.

Interestingly, according to 2020 data, in most countries, females are more likely to enroll in tertiary education than males, with a gross enrollment rate of 43% for females compared to 37% for males. Of the countries with available data, 106 countries show a difference in favor of women. However, this does not directly translate into parity in STEM fields, as noted above with the graduation figures. This suggests that, although women are accessing tertiary education in higher proportions, there are still barriers or factors that influence their choice and persistence in STEM disciplines.

It is necessary to remember the importance of counseling in making young people aware of trajectories that they might not otherwise have considered. This implies that educational and counseling interventions can play a crucial role in challenging gender stereotypes and broadening female students' perspectives on STEM careers.

The implementation of these types of innovative activities could potentially foster greater interest in technology among all students, including girls, if they are designed in an inclusive and gender-sensitive manner.

In summary, to address gender bias and stereotypes in STEM, it is important to recognize the existence of a gap from an early age, implement initiatives that foster interest in STEM before stereotypes become entrenched, provide mentoring that broadens the perspectives of female students, and ensure that pedagogical innovations in STEM are inclusive.

Chapter 2: Description of Holograms and VR/AR Advanced Tools - The Supportive Hardware

Supportive Hardware for STEM Education

2.1 Introduction: Holograms in STEM Education

Holographic and VR/AR hardware transform abstract STEM concepts into hands-on, three-dimensional experiences. Instead of reading about structures or viewing flat images, learners can observe, manipulate, and test virtual models in real time. This leads to stronger engagement, improved spatial understanding, safer experimentation, and better long-term retention. These technologies are increasingly adopted because they:

- Enable safe repeats of risky experiments and hazardous demonstrations.
- Lower the barrier to advanced lab equipment by delivering virtual equivalents.
- Support differentiated instruction and inclusion through multimodal learning.
- Combine with curriculum mapping and assessment tools for measurable outcomes.

2.2 zSpace 3D Holographic Laptop

2.2.1 Overview

The zSpace 3D Holographic Laptop is a purpose-built educational workstation that produces stereoscopic, “hologram-like” 3D images viewable without heavy headsets. It marries a high-quality stereoscopic display, head/face tracking, and a responsive haptic stylus to create a natural, hands-on interaction with virtual objects.

Why educators use zSpace:

- **Natural interaction:** Using a pen-like stylus that feels like a real tool, students can hold, rotate, slice, and assemble 3D models.
- **No headset needed:** Reduces hygiene concerns and makes collaboration easier because students can gather around a single screen.
- **Curriculum alignment:** Bundled content and third-party apps are designed to map directly to common educational standards (e.g., biology dissection, physics labs, engineering assemblies).

- **Scalable pedagogy:** Works as a teacher-led station for demonstrations, as a paired workstation for small groups, or as individual practice stations.

How the experience feels: students see depth cues (objects pop forward/back), can approach the screen to inspect detail, use the stylus to slice through materials (e.g., an organ), and feel subtle haptic feedback for a tactile sense of interaction.

Figure 1: Basic features

2.2.2 What's included (package)

Typical package for a zSpace station (may vary by vendor/contract):

- **zSpace laptop or All-In-One unit with integrated stereoscopic display**
- **Haptic stylus (with spare tips)**
- **Polarized glasses or, on newer models, no glasses needed (face tracking)**
- **Power adapter and cables**
- **Preinstalled education software suite and sample lesson files**
- **Quick start guide and warranty paperwork**
- **Optional: headstrap, carrying case, extra stylus tips, keyboard/mouse**

Figure 2: Official product photo of the zSpace laptop with stylus and glasses

2.2.3 Key hardware features & how they work

1. **Stereoscopic 3D Display**
    - Two slightly different images are rendered (one per eye) producing depth perception.
    - Display brightness and calibration are important — improper settings can reduce the 3D effect.
2. **Face/Head Tracking**
    - Cameras or sensors track the user's viewpoint in real time.
    - The rendered scene shifts with head movement, preserving realistic parallax and perspective.
3. **Haptic Stylus**
    - Provides 6 degrees of freedom (x/y/z movement + pitch, yaw, roll).
    - Pressure sensitivity and haptic feedback simulate touch and resistance.
    - Used for selection, drawing, cutting/slicing, and force/torque simulations.
4. **Processing & Storage**
    - Built on Windows with mid-to-high performance CPUs and SSDs to load large 3D models and run simulations smoothly.
    - GPU and RAM specs vary by model; higher specs improve performance in complex scenes.
5. **Connectivity**

- Standard ports (USB, HDMI, Ethernet) for peripherals, network classroom deployments, and external displays.

6. **Preloaded & Third-party Software**

- zSpace platforms ship with a curated library of STEM content; they also support additional third-party applications that are education-ready.

	zSpace Inspire	zSpace Inspire 2	zSpace Inspire 2 Pro
Operating System	Windows 11 Pro 64-bit	Windows 11 Pro 64-bit	Windows 11 Pro 64-bit
CPU and Chipset	Intel® Core™ i5-11400H processor	Intel® Core™ i5-13420H processor	Intel® Core™ i7-13620H processor
Memory	Dual-channel 16GB DDR4 SDRAM	Dual-channel 16GB DDR5 SDRAM	Dual-channel 32GB DDR4 SDRAM
Display	15.6" HD Display with IPS technology Ultra HD 3840 x 2160 in 2D mode, Acer ColorBlast technology, Pantone® validated, Delta E<2, 100% Adobe RBG color gamut, SpatialLabs 3D Stereoscopic module, 1920 x 2160 in 3D mode	15.6" HD Display with IPS technology , Ultra HD 3840 x 2160 in 2D mode, Acer ColorBlast technology, Pantone® validated, Delta E<2, 100% Adobe RBG color gamut, SpatialLabs 3D Stereoscopic module, 1920 x 2160 in 3D mode	15.6" HD Display with IPS technology Ultra HD 3840 x 2160 in 2D mode, Acer ColorBlast technology, Pantone® validated, Delta E<2, 100% Adobe RBG color gamut, SpatialLabs 3D Stereoscopic module, 1920 x 2160 in 3D mode
Graphics	NVIDIA® GeForce RTX™ 3060 with an 6GB GDDR6 VRAM	NVIDIA® GeForce RTX™ 4050 with an 6GB GDDR6 VRAM	NVIDIA® GeForce RTX™ 4050 with 6GB GDDR6 VRAM
Storage	512 GB SSD, PCIe Gen4, 16 GB/s, NVMe	512GB PCIe Gen4, 16 Gb/s, NVMe SSD	1TB PCIe Gen4, 16 Gb/s, NVMe SSD
Webcam	1280 x 720 resolution 720p HD audio/video recording	1280 x 720 resolution 720p HD audio/video recording	1280 x 720 resolution 720p HD audio/video recording
Eye-Tracking Camera	1280 x 480 resolution (VGA x 2) with SpatialLabs technology	1280 x 480 resolution (VGA x 2) with SpatialLabs technology	1280 x 480 resolution (VGA x 2) with SpatialLabs technology
Wireless and Networking	Intel® Wireless Wi-Fi6 AX201 802.11a/b/g/n/acR2+ax wireless LAN Supports Bluetooth® 5.1 Gigabit Ethernet, Wake-on-LAN ready	Intel® Wireless Wi-Fi6 AX201, 802.11a/b/g/n/acR2+ax wireless LAN, Supports Bluetooth® 5.1, Gigabit Ethernet, Wake-on-LAN ready	Intel® Wireless Wi-Fi6 AX201, 802.11a/b/g/n/acR2+ax wireless LAN, Supports Bluetooth® 5.1, Gigabit Ethernet, Wake-on-LAN ready
I/O - Ports and Connectors	USB 3.2 Gen 2, USB Type C / Thunderbolt 4, DisplayPort 1.4, HDMI port with HDCP support, SDCard reader, 1000mb Ethernet (RJ-45) port	USB 3.2 Type-C w/ Thunderbolt™ 4 port, 3x USB A 3.2 Type A ports, HDMI port with HDCP support, Ethernet (RJ-45) port	USB 3.2 Type-C w/ Thunderbolt™ 4 port, 3x USB A 3.2 Type A ports, HDMI port with HDCP support, Ethernet (RJ-45) port

Figure 3: Infographic of the laptop's main specs (zSpace Inspire version)

zSpace Imagine

Operating System
Windows 11 Pro 64-bit

CPU and Chipset
Intel® Core™ i7-1360P Processor 18M Cache, up to 5.00 GHz

Memory
16GB DDR4 (1x16) SODIMM

Display
14 inch QHD (2K) 2240x1400px in 2D Mode, 1220x700px in 3D Mode

Graphics
Intel® Iris® Xe Graphics

Storage
512GB PCIe 3.0 SSD

Webcam
1280 x 720 resolution, 720p HD audio/video recording

Eye-Tracking Camera
1280x480 resolution (VGAx2)

Wireless and Networking
Intel® Wi-Fi 6E AX210

I/O - Ports and Connectors
3x USB-C (PD,DP,Data) 2x USB-A 3.2 HDMI Ethernet RJ45 MicroSD Card Reader 3.5mm Audio Jack Kensington Mini Lock

Figure 4: Infographic of the laptop’s main specs (zSpace Imagine version)

2.2.4 Typical educational use cases

- **Biology & Health Sciences:** Virtual dissections, organ systems exploration, surgical procedure previews.
- **Chemistry & Molecular Biology:** 3D molecular models, bonding and reaction visualization.
- **Physics & Engineering:** Force vectors, mechanical assemblies, circuitry simulations.
- **Vocational Training:** Automotive systems, HVAC, architectural visualization.
- **Mathematics & Geometry:** 3D geometry, topological explorations, spatial reasoning tasks.

2.2.5 Advantages & considerations

Advantages

- **High fidelity 3D interaction:** True stereoscopic rendering gives accurate depth cues for critical thinking in STEM.
- **Tactile control via stylus:** Supports precise manipulation and develops fine motor skills linked to technical tasks.
- **Collaborative classroom use:** Multiple students can view the same content and take turns interacting.
- **Hygiene & accessibility:** No full-face headsets reduces shared contact points and is easier for students with certain disabilities.

Considerations / Constraints

- **Cost & procurement:** Higher unit price vs mobile solutions; licensing and support contracts can add recurring costs.
- **Physical footprint:** Typically used as a semi-fixed station; not designed for rapid classroom mobility.
- **Environmental needs:** Optimal tracking requires controlled lighting and minimal reflections on the screen.
- **User comfort:** Extended sessions may cause visual fatigue in some users; session duration guidelines recommended (e.g., breaks every 20–30 min for younger students).
- **Software & updates:** Licensing often requires periodic renewals and occasional updates that must be managed centrally.

2.2.6 Online resources & further reading

When setting up or expanding a holographic lab, look for:

- Official manufacturer resources for downloads, firmware, and lesson plans.
- Teacher forums and case studies for curriculum integration ideas.
- Compatibility lists for third-party educational apps.

2.2.7 Quick start — zSpace (step-by-step)

1. Unpack unit and accessories; place zSpace on a stable desk avoiding direct sunlight and reflective surfaces.
2. Connect power and network. Power on and allow first-boot software configuration.
3. Attach / calibrate polarized glasses or enable face-tracking per device guide.
4. Test stylus tracking using a sample model: check for lag, drift, or calibration issues.
5. Install or verify access to preloaded lesson content; run a teacher demo.
6. Create simple rotation plan for student interaction to ensure everyone gets hands-on time.

2.2.8 Maintenance & troubleshooting

Maintenance Basics:

- Keep the unit in a **dust-free, dry environment**.
- **Clean the screen and glasses** regularly with lint-free microfiber cloths.
- **Replace stylus tips** when worn (keep spare tips on hand).

Common Issues & Solutions:

- **No 3D effect visible:**
  1. Ensure the head-tracking glasses are powered and aligned.
  2. Confirm the glasses' connection (if wireless) or that they are properly seated (if wired).
- **Stylus not responding:**
  1. Check USB or wireless connection.
  2. Replace batteries or recharge the stylus (depending on model).
  3. Inspect stylus tip for damage—replace if worn.
- **Head tracking inaccurate or laggy:**
  1. Clean camera lenses and tracking sensors.
  2. Improve lighting—avoid glare or very low light.
- **Software crashes or sluggish performance:**
  1. Update the zSpace software, Windows OS, and graphics drivers.
  2. Close other apps using system resources.
  3. Reboot the machine and restart the application.
- **Connectivity problems (Wi-Fi or network):**
  1. Restart routers or switch to a wired Ethernet connection.
  2. Verify network settings and firewall exceptions if needed.
- **Dim image or reduced display quality:**
  1. Adjust brightness in display settings.
  2. Check for screen obstructions or glare from lights and reposition if needed.
- **Eye strain or double vision:**
  1. Schedule regular breaks—typically after 20–30 minutes of continuous use.
  2. Encourage students to blink and look away periodically.
- **Software licensing issues:**
  1. Verify subscription status and licensing agreements.
  2. Contact vendor support for renewal or troubleshooting.
- **Calibration failures:**

1. Re-run calibration tool.
2. Restart device if issues persist.

2.2.9 Safety, ergonomics & best practices

- Encourage neutral posture: keep screen at comfortable viewing height, stylus usage at relaxed wrist angle.
- Limit continuous sessions for younger learners (break every 20–30 minutes).
- Clean shared stylus grips and glasses between uses with approved wipes.
- Provide supervision during high-immersion tasks to monitor fatigue or discomfort.

2.3 VR Headsets Compatible with Mobile Phones

2.3.1 Overview

Mobile-based VR uses a student's smartphone as the display and processor. A headset shell holds the phone and contains lenses that split the screen into stereoscopic images. These solutions are highly attractive for schools due to minimal hardware costs, low setup complexity, and the vast availability of mobile educational apps.

Mobile VR is ideal when:

- Budget constraints exist.
- Mobility and quick distribution are priorities (e.g., rotating groups or take-home kits).
- The goal is broad access to immersive experiences rather than high-fidelity simulation.

Educational strengths: accessibility, rapid deployment, and diverse content libraries and lesson plans from multiple app vendors.

2.3.2 What's included (typical)

- Headset shell (foam, plastic, or cardboard)
- Adjustable head straps and padding
- Lens assembly with IPD (interpupillary distance) adjustment (in many models)
- Phone cradle or clips to secure device
- Quick start instruction and safety notice
- Optional Bluetooth controller or tethered button

2.3.3 Common models in education

1. **Merge AR/VR Headset**
    - Classroom-grade soft foam, easy to disinfect, adjustable IPD, glasses-friendly.
    - Integrates with the Merge Cube for AR hand-held objects and Merge EDU app content.
    - Recommended for K–8 and middle school STEAM activities.
2. **Homido (Grab / Prime)**

- More ergonomic plastic shell and refined optics; adjustable focus; higher comfort for older students.
- Works across a wide range of phone sizes and OS.

3. **Google Cardboard**

- Low-cost, DIY approach that democratized mobile VR.
- Good for introductory lessons and when the teacher wants to equip many students cheaply.

4. **Other notable classroom devices**

- Foam/ABS headsets with replaceable face foam for hygiene.
- MR/AR adapters that add passthrough camera functionality for mixed reality overlays.

Figure 5: Models of VR Headsets

2.3.4 Features in detail

Portability & setup

- Lightweight and small footprint; easily stored in classroom bins.
- Setup is typically: insert phone → secure → adjust straps/lenses → launch app.

Optical adjustments

- IPD controls and focus dials help reduce blur and eye strain.
- Proper adjustment is essential for comfort and immersion — train students to tune settings.

Controls & interaction

- Gaze-based controls (hold focus for selection).
- Simple external Bluetooth controllers for more complex interactions (gamepad-style).
- Some apps use single-button triggers or head movement for navigation.

Field of View (FOV) & immersion

- FOV ranges typically from ~90° to 110°; larger fields deliver stronger presence.

Thermal & battery

- Phone may heat under heavy load — plan short sessions and allow cooling time between uses.

2.3.5 Educational applications

- **Virtual field trips:** museums, cultural tours, planetarium experiences.
- **Science exploration:** interactive 3D models of cells, ecosystems, astronomy.
- **Language & cultural immersion:** simulated conversations, street tours, historical reconstructions.
- **Contextual storytelling & empathy building:** immersive first-person narratives to support social studies and literature.

2.3.6 Advantages & considerations

Advantages

- **Cost efficiency:** headsets are inexpensive; the phone is leveraged as the compute/display platform.
- **Scalability:** can deploy dozens of units quickly for large classes.
- **Vast content ecosystem:** thousands of VR apps and 360° videos exist for education.

Considerations

- **Quality variance:** the experience depends heavily on phone hardware (display resolution, framerate, sensors).
- **Comfort & fit:** ill-fitting units cause headaches, fogging, or motion discomfort.
- **Session length:** longer sessions increase risk of cybersickness — recommend moderate session lengths and monitoring.
- **Hygiene:** shared foam interfaces require cleaning protocols; consider replaceable face pads or disposable liners.
- **Content curation:** not all apps are education-grade — pretest and vet apps for age appropriateness and learning alignment.

2.3.7 Quick start — mobile VR (step-by-step)

1. Inspect headset and clean face pads.
2. Fully charge phones or use devices with >50% battery.

3. Install and preconfigure the selected app(s); download any large media beforehand.
4. Insert phone into the cradle and secure straps. Adjust IPD and focus.
5. Run a short calibration and demo for students.
6. Use a rotation schedule: 5–15 minute immersive activity + 5–10 minute debrief.

Figure 6: Example of how to set up VR Headset

2.3.8 Maintenance, hygiene, & safety

- Use alcohol-free disinfectant wipes safe for foam and lens areas or change disposable liners after each use.
- Limit continuous exposure; schedule breaks.
- Supervise students the first few times to detect discomfort.
- Replace worn face foam and inspect lenses for scratches.

2.4 Comparison & Summary Table

Dimension / Need	zSpace 3D Holographic Laptop	Mobile-Compatible VR Headset
Primary display	Integrated stereoscopic 3D display (no full headset)	Smartphone screen inside a headset
Interaction method	Haptic stylus (6DoF), face/head tracking	Head tracking via phone sensors; controllers optional
Installation	Semi-fixed station; needs power & light control	Minimal — portable; requires phone battery
Content richness	High fidelity, curriculum-aligned simulations	Wide app library; variable fidelity

Dimension / Need	zSpace 3D Holographic Laptop	Mobile-Compatible VR Headset
Cost (relative)	High	Low
Scalability	Moderate (cost per unit)	Very high (cheap headsets + phones)
Hygiene	Lower contact (no shared headsets)	Higher hygiene needs for shared face pads
Ease of teacher use	Requires PD for full integration	Quick to learn; app-specific training ideal
Best use cases	In-depth labs (dissections, engineering assembly)	Virtual tours, supplementary immersion, large-scale demos
Limitations	Cost, physical footprint	Dependence on phone specs, comfort issues

2.5 Safety, Accessibility & Legal Notes

- Follow manufacturer safety recommendations for ages and continuous use time.
- Provide alternatives for students with photosensitivity, vestibular disorders, or other conditions that make VR unsuitable.
- Manage user data and privacy when accounts or tracking are involved — consult your institution's policy.

Chapter 3: Description of the Educational Software for Holograms and Free Online Available VR/AR Educational Software

3.1Introduction: Educational Software for Holograms and VR/AR

Educational software is the instructional engine that makes holographic and VR/AR hardware useful in classrooms. Good XR software is optimized for 3D interaction (stylus, gaze, or controllers), aligned to curricular goals, scaffolded for learners, and provides teacher-management and assessment features so the experience produces measurable learning outcomes.

3.2 VR/AR Educational Software Bundled with the zSpace 3D Holographic Laptop

3.2.1 zSpace Software Suite

When schools buy a zSpace laptop they gain access to a curated ecosystem of applications (native and web/A3 versions), teacher guides/lessons, and management tools that are specifically designed for the zSpace stereoscopic display and haptic stylus. zSpace bundles both vendor and third-party content and provides an App Manager / zCentral portal to install, launch, and update apps across devices. (Z Space, zSpace Support)

Career Coach AI

What it is: an AI-powered career-readiness application that links zSpace experiences and content to real-world career pathways and provides personalized recommendations and interactive mini-tasks to explore careers. (zSpace Support, Z Space)

Core features

- AI-driven guidance that suggests career clusters based on student interests and activities.
- Short interactive simulations and tasks that reflect job activities (e.g., basic lab tasks, measurement, diagnostic thinking) so students can sample "day-in-the-life" tasks.
- Reporting dashboard for educators to see student choices and reflect on readiness indicators. (zSpace Support)

Classroom uses & pedagogy

- *Career exploration lessons*: assign a set of careers and have students complete related micro-simulations, then discuss skills required.
- *CTE integration*: use as a warmup before a unit in vocational/technical courses to connect skills to jobs.
- *Portfolio prompts*: students capture screenshots / short reflections to add to career portfolios.

Teacher controls & assessment

- Teachers can seed activities and review student responses; use results to guide counseling or further work. (zSpace Support)

Access / tech notes

- Delivered via zSpace App Manager / zCentral and requires license access; consult zSpace support for account provisioning. (Z Space)

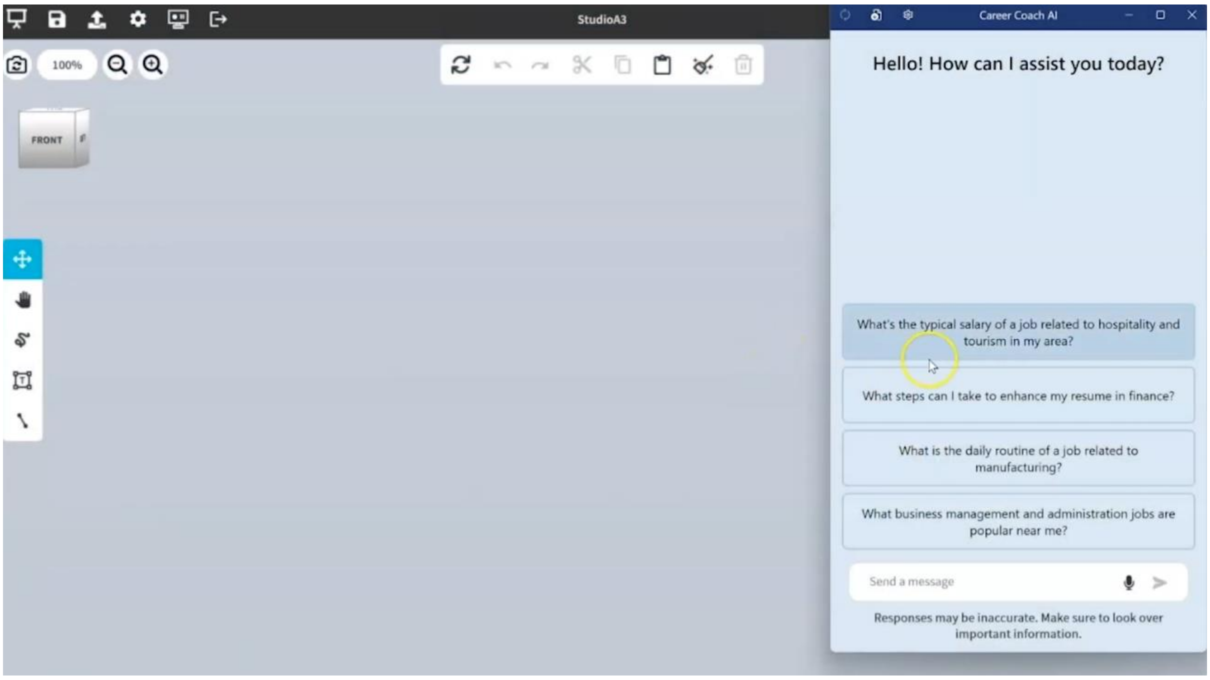

Figure 7: Career

Coach AI

Experiences (zSpace Experiences)

What it is: a set of standards-aligned experiential simulations spanning Earth, Life, and Physical Science (often with NGSS alignment). These are teacher-ready simulations with prebuilt lessons that let students manipulate environments and collect data. (zSpace Support, the Learning Counsel)

Core features

- Interactive, scenario-based modules (e.g., “Beach & River Erosion”) with manipulable variables.
- Data collection and export (tables, images, multiple-choice checkpoints) for formative assessment.
- Multi-sensory feedback in some simulations (visual + simulated haptic cues). (zSpace Support)

Classroom uses & pedagogy

- Inquiry cycles: pose a question → run simulation while changing variables → collect data → analyze → conclude.
- Built-in lesson plans reduce teacher prep time and map to standards.

Teacher controls & assessment

- Teacher can set conditions, pause/resume, and collect student artifacts for grading. (zSpace Support)

Access / tech notes

- Delivered through zSpace’s app ecosystem; some Experiences are native apps, others appear in zCentral. (Z Space)

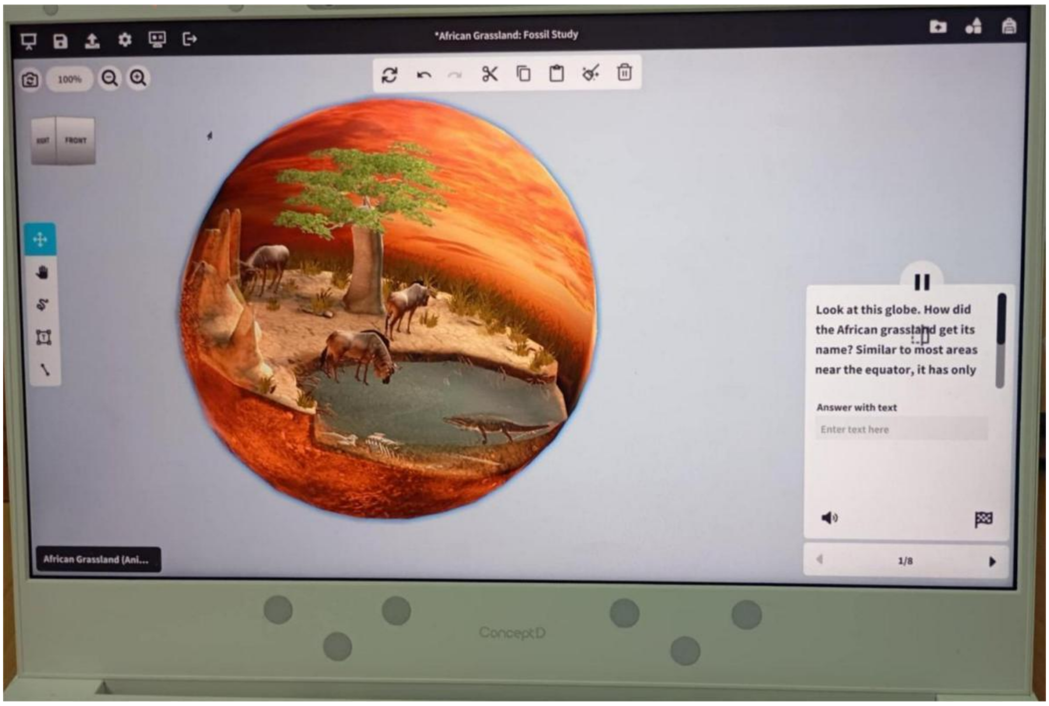

Figure 8: zSpace Experiences

Franklin's Lab A3

What it is: an A3 web application focused on electricity and circuits — students can build circuits, measure voltages/current, and troubleshoot broken circuits in a simulated, safe environment. (zSpace Support)

Core features

- Virtual components: resistors, batteries, switches, LEDs, meters.
- Troubleshooting scenarios where students must diagnose and fix faults.
- Measurement tools that mimic real-world instruments (multimeter functionality). (zSpace Support)

Classroom uses & pedagogy

- Ideal for middle/high-school physical science and introductory electronics: teacher demos, guided labs, or independent practice.
- Use for formative assessment: present a broken-circuit scenario, ask students to record steps and solution.

Teacher controls & assessment

- Teachers can launch exercises, monitor student progress, and assign tasks through zCentral or the Studio/A3 interface. (zSpace Support)

Access / tech notes

- Franklin's Lab A3 offers a web version (A3) that runs in supported browsers — useful for students who need to continue work off the zSpace device. Check zSpace support for supported browsers and deployment details. (zSpace Support)

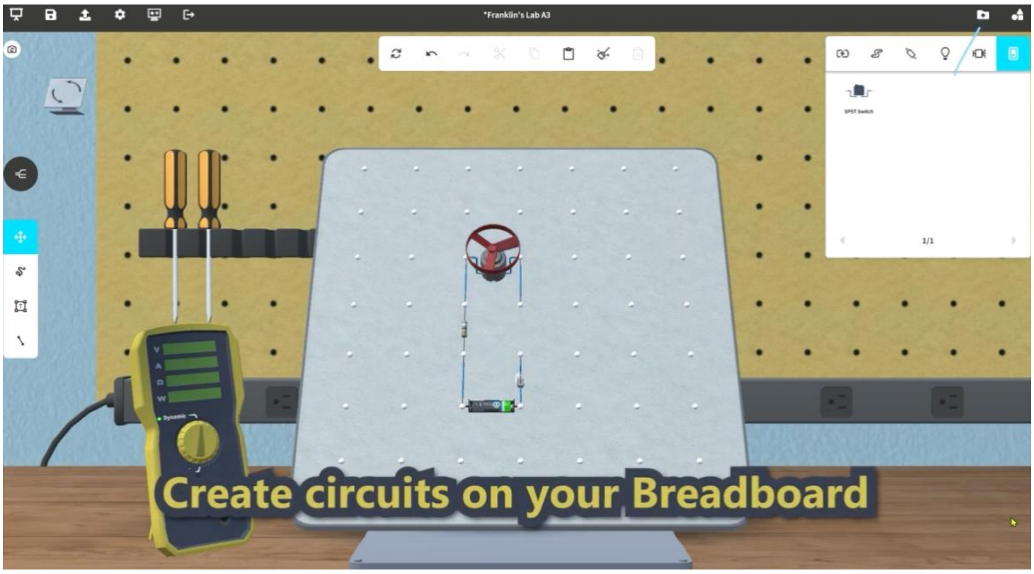

Figure 9: Franklin's Lab A3

Math Island A3

What it is: a 3D, story-driven math environment that teaches measurement, coordinates, angles, and basic data skills using interactive island tasks and puzzles. (zSpace Support, mathisland.zspace.com)

Core features

- 3D models that students measure, compare, and manipulate to solve problems.
- Coordinate plane activities, angle/area/volume tasks, and embedded formative checkpoints.
- Game-like missions that motivate practice and scaffold concepts. ([zSpace Support]())

Classroom uses & pedagogy

- Use for differentiated practice: students progress at their own pace through island missions.
- Pair with explicit instruction: teacher models problem solving, then students complete related island tasks.

Teacher controls & assessment

- Teachers can assign islands/missions and review student responses; A3 web mode enables homework continuity. ([zSpace Support]())

Access / tech notes

- Math Island provides an A3 web option so work can continue on non-zSpace devices via supported browsers (teacher code / account required). ([zSpace Support]())

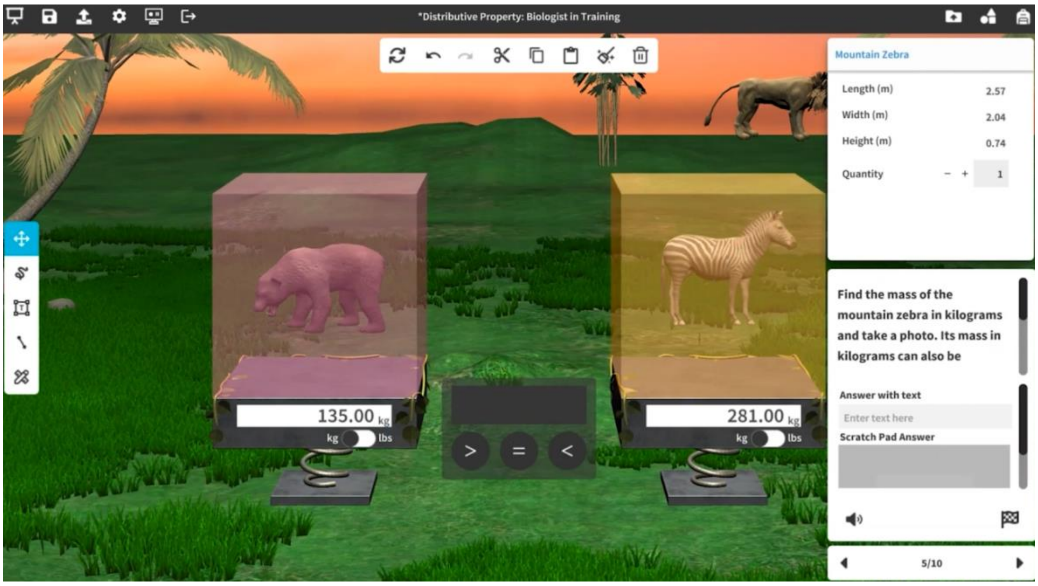

Figure 10: Math Island A3

Newton's Park A3

What it is: an open physics playground for experimenting with forces, motion, energy transformations and simple machines. It emphasizes discovery through building simulations and manipulating physical variables. ([zSpace Support]())

Core features

- Sandbox tools to create collisions, levers, ramps, and change gravity/time settings.
- Ability to record and replay experiments to analyze results.
- Visualizations of vectors, trajectories, and energy flow. ([zSpace Support]())

Classroom uses & pedagogy

- Excellent for guided inquiry: students form hypotheses (e.g., "How does ramp angle affect speed?"), run trials, and collect data.
- Use as exploratory lab time prior to formal assessment.

Teacher controls & assessment

- Teachers can set up scenarios, define variables, and collect student artifacts; A3 web support allows out-of-class access. (zSpace Support, Newton's Park)

Access / tech notes

- Newton's Park A3 is accessible via zSpace's web play interface with teacher account codes for student access. (zSpace Support)

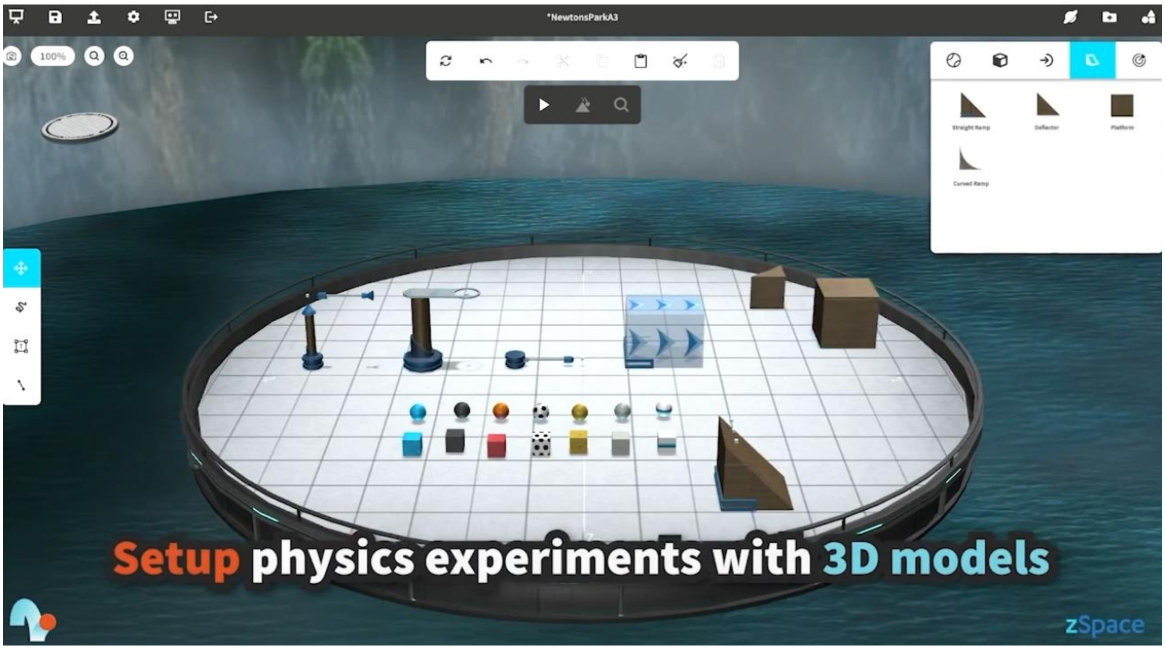

Figure 11: Newton's Park A3

Studio A3

What it is: a creation and authoring environment (A3 web variant available) where students and teachers assemble lessons, annotate models, add text/callouts, draw in 3D, and author guided activities. It's the "teacher/creator" side of the zSpace content ecosystem. (zSpace Support, Zspace Studio)

Core features

- 3D drawing and annotation tools (text, lines, shapes).
- Ability to build slide-style sessions: sequence models, add questions, insert callouts and assignments.
- Export/share functionality so student work or teacher lessons can be reused. (zSpace Support)

Classroom uses & pedagogy

- Teachers author interactive lessons (e.g., guided anatomy walkthrough) that students later complete.
- Students use Studio to build portfolios or create science explanations in 3D.

Teacher controls & assessment

- Studio supports teacher-authored assessments (embedded multiple-choice, short responses) and teacher review of student submissions.
- Web/A3 Studio lets classes continue off-device for homework projects. (zSpace Support)

Access / tech notes

- Studio A3 requires teacher provisioning and codes for student access; many schools use Studio to create their own zSpace content. (Zspace Studio, zSpace Support)

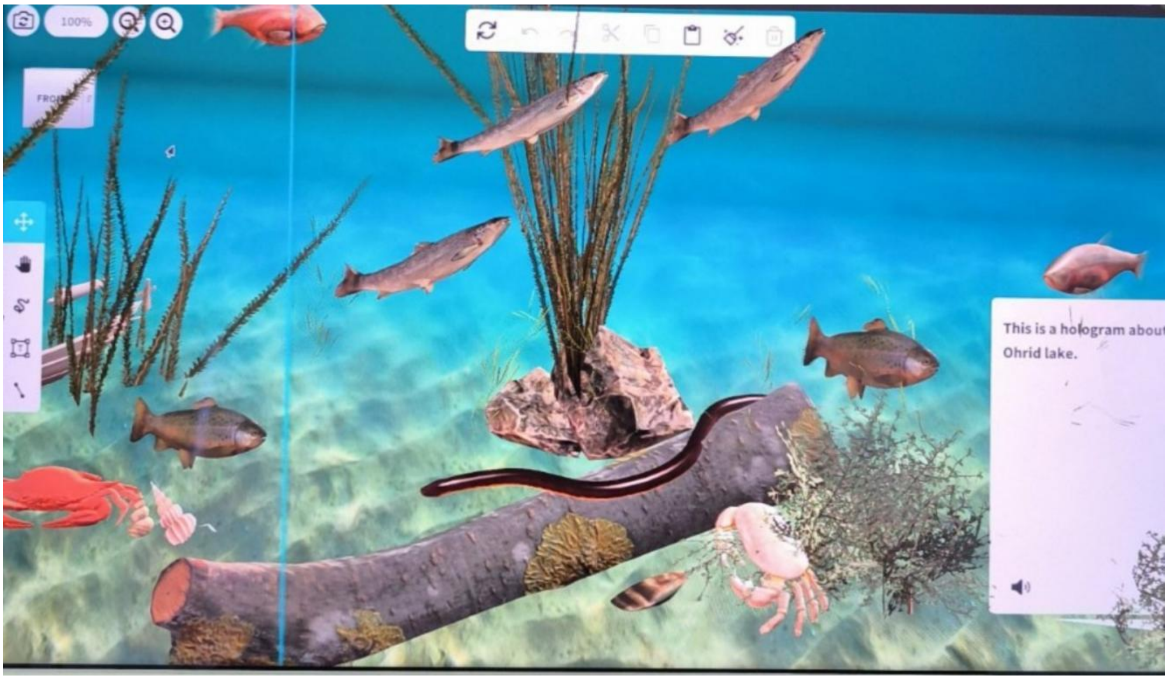

Figure 12: Studio A3

Toybox (zSpace Toybox)

What it is: a creative sandbox / maker app that lets learners manipulate playful 3D objects, design simple toys or artifacts, and in some workflows connect to 3D printing / maker workflows. (zSpace distributes Toybox via the App Manager.) (zSpace Support, Google Play)

Core features

- Library of prebuilt toys/models to explore and customize.
- Simple creation tools for students to modify shapes, colors, and features.
- (Optional) export/print workflow when paired with compatible 3D printers or external Toybox services. (zSpace Support, Google Play)

Classroom uses & pedagogy

- Great for STEAM, design thinking, and maker-education sessions.
- Use as a problem-solving challenge: design a small object that meets constraints (weight, size, function) then iterate.

Teacher controls & assessment

- Teachers can assign challenges, inspect student builds, and use Toybox as a formative creative assessment.

Access / tech notes

- Toybox is distributed through the zSpace App Manager; check version notes and language options in App Manager before deployment. (zSpace Support)

Figure 13: zSpace Toybox

Tilt Brush (zSpace port)

What it is: a 3D painting application allowing users to paint and sculpt in three-dimensional space using a variety of brushes and effects — adapted to work on zSpace systems so students can create 3D art without a headset. (zSpace Support, zspace.my.site.com)

Core features

- Dynamic brushes that paint in 3D (strokes exist as volumetric objects).
- Layering, color selection, and effects that support creative expression.
- Export options for saving artworks or incorporating them into Studio lessons. (zSpace Support)

Classroom uses & pedagogy

- Use in art/visual design units to explore space, form, and composition.
- Cross-curricular projects: create visualizations for science topics or illustrate narrative scenes in language arts.

Teacher controls & assessment

- Teachers can set creation prompts and evaluate students on creativity, technical skill, and concept communication.

Access / tech notes

- Tilt Brush for zSpace is listed among compatible zSpace apps; follow App Manager instructions to install. (zspace.my.site.com)

Figure 14: Tilt Brush

VIVED Science (by VIVED Learning)

What it is: a third-party, research-based 3D science curriculum package integrated into the zSpace ecosystem. VIVED Science provides hundreds of interactive 3D models and activities aligned to NGSS and the 5E instructional model. (Vived Learning, zSpace Support)

Core features

- Large library (~250+ models) covering anatomy, earth science, microbiology and more.
- Authoring features that let teachers assemble sessions, add labels/callouts, and embed questions.
- Pre-built lesson plans designed for classroom readiness and assessment. (Vived Learning, YouTube)

Classroom uses & pedagogy

- Formal labs: students use models to make observations, label structures, and complete scaffolded investigations.
- Substitute for wet labs where resources or safety are constraints.

Teacher controls & assessment

- Teachers can create sessions, hide/show parts of models, ask formative questions, and export student artifacts for grading. (zSpace Support)

Access / tech notes

- VIVED Science is licensed separately; zSpace provides a setup and license guide for activation and management. It is commonly installed via zSpace App Manager. (zSpace Support)

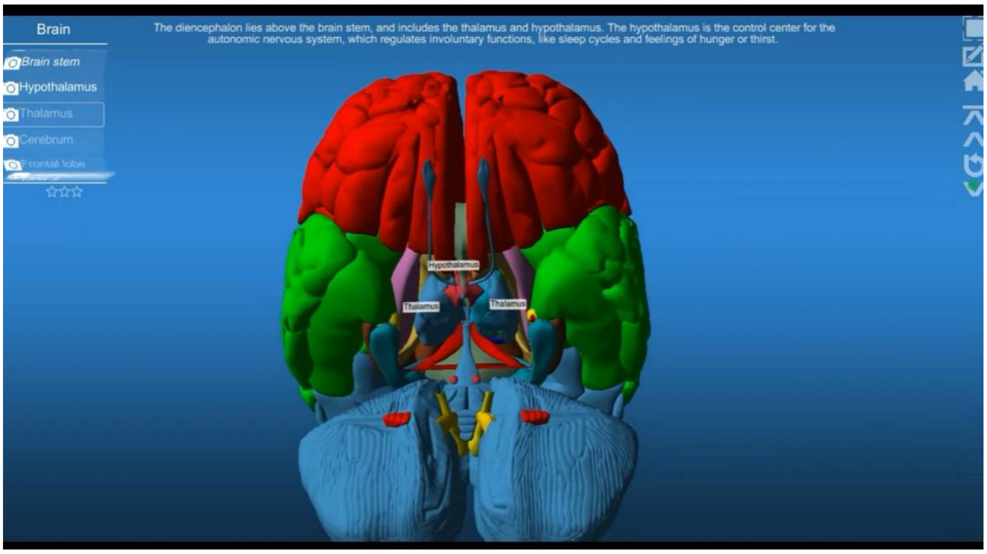

Figure 15: VIVED Science

zCentral (zSpace content & management portal)

What it is: the zCentral portal (sometimes called zCentral / zSpace Web) is the central launch point for discovering, installing, and launching zSpace experiences and applications. It also provides navigation for teacher resources and content libraries. (go.zspace.com, zSpace Support)

Core features

- Unified catalog of apps, activities, and models.
- Links to lesson plans, teacher guides, and support articles.
- “Open zSpace Web Support Service” utility to launch A3/web apps. (zspace.my.site.com)

Classroom uses & pedagogy

- Use zCentral as the teacher’s dashboard to queue apps for lessons and to manage student access.

Access / tech notes

- zCentral requires zSpace system software and may prompt users to install a helper tool to run native or web apps. Follow zSpace support for zCentral configuration. (zSpace Support, zspace.my.site.com)

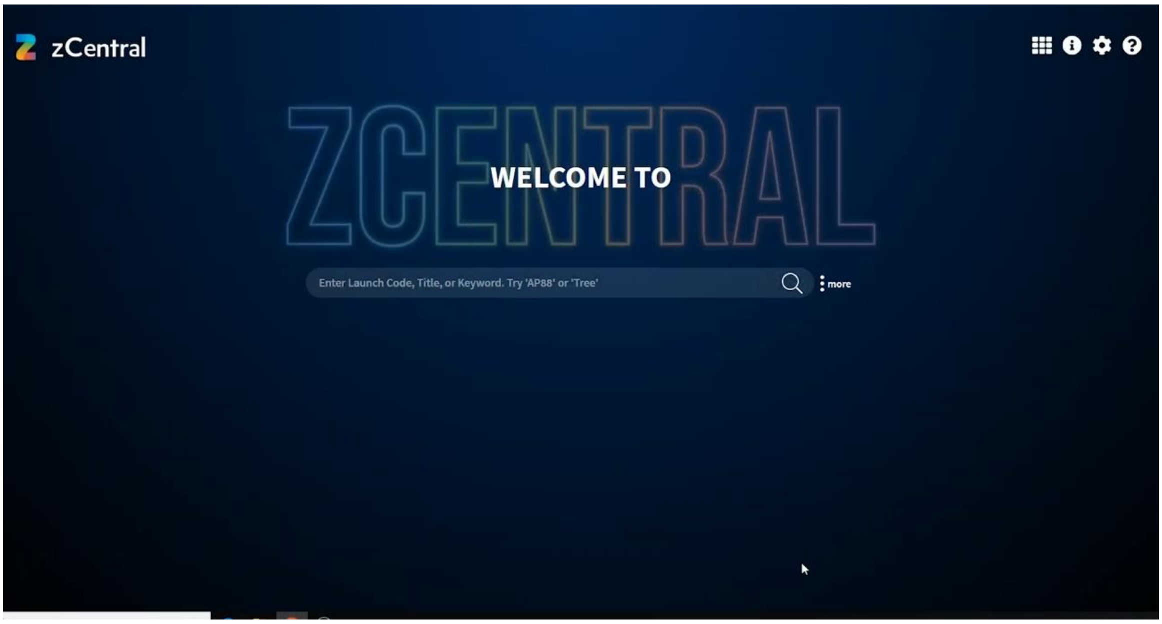

Figure 16: zCentral

zSpace Explore

What it is: a discovery / demo collection that allows users to quickly access short, cross-grade learning environments and demo activities — useful for teacher demos, student exploration, or demoing zSpace capabilities to stakeholders. (zSpace Support, YouTube)

Core features

- Short, scaffolded walkthroughs across several subjects and grades.
- Quick-start demo content that showcases zSpace pedagogy and interaction patterns.
- Ideal for teacher onboarding and getting students familiar with 3D interactions. (zSpace Support)

Classroom uses & pedagogy

- Use Explore as bell-work, warm-ups, or demonstration content before full lessons.

Access / tech notes

- zSpace Explore entries are available from zCentral / App Manager and often used for quick showcases. (zspace.my.site.com)

Figure 17: zSpace Explore

zView

What it is: a sharing/presentation tool that projects a user's zSpace view to a second monitor or projector; it also supports an "augmented" display mode for showing a pseudo-3D view to an audience (zView requires an external USB camera for the augmented mode). (zSpace Support)

Core features

- Screen-share mode: mirror the zSpace display on an external screen.
- Augmented mode: project a "lifted" 3D view for the audience by compositing camera imagery with the 3D model.
- Useful in whole-class instruction so everyone can see details the user is manipulating. (zSpace Support)

Classroom uses & pedagogy

- Teacher demos and whole-class walkthroughs. Use zView to collect student attention on a single model manipulated by the teacher or a student.

Access / tech notes

- zView requires the zSpace system software and (for augmented mode) a compatible USB camera; consult zView setup guides for supported hardware and resolution tips. (zSpace Support)

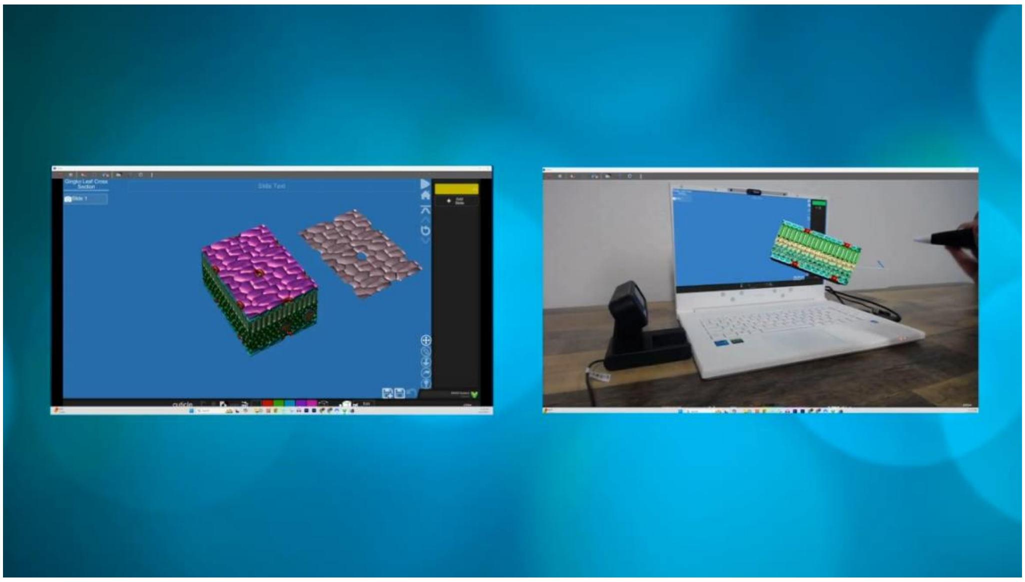

Figure 18: zView

3.2.3 Features enhancing the learning experience

- **Teacher authoring (Studio A3):** create scaffolded, standards-aligned lessons. (zSpace Support)
- **A3 web continuity:** many zSpace apps (Math Island A3, Franklin's Lab A3, Newton's Park A3, Studio A3) have web/A3 versions so students can continue work off the zSpace device in a supported browser. (zSpace Support)
- **App management:** IT teams use zSpace App Manager to install and update apps centrally. (zSpace Support)

3.2.4 Software updates, deployment & technical tips

- Use the **zSpace App Manager** to install, update and roll back apps centrally; test updates on one unit before mass deployment. (zSpace Support)
- For A3/web apps, confirm supported browsers and network ports (zSpace provides network diagnostic tools and support notes). (zSpace Support)
- Many apps require teacher accounts / codes (Studio A3, Newton's Park A3, Math Island A3) — plan account provisioning during the pilot phase. (Zspace Studio, Newton's Park)

3.2.5 Licensing & access model

- zSpace licenses are typically per device or per seat and third-party content (e.g., VIVED Science) may require separate licensing and activation via App Manager. Check zSpace support pages for each app's licensing and activation workflow. (zSpace Support)

3.3 Summary

zSpace's bundled software ecosystem is broad and intentionally diverse: it mixes teacher-authoring tools (Studio A3), subject-specific labs (Franklin's Lab A3, Newton's Park A3, Math Island A3), creative tools (Tilt Brush, Toybox, Studio), third-party curricular suites (VIVED Science), and management/presentation utilities (zCentral, zView). Together they turn the zSpace laptop into a complete instructional environment — not just a display — enabling teachers to run standards-aligned, interactive STEM lessons with built-in assessment and continuity via A3/web apps. (Z Space, zSpace Support)

Chapter 4: The Best ICT-Based Practices and OER Tools in Tackling Students' Academic Underachievement in STEM

1. Case Studies and Examples from Partner Schools

Case Study 1: Interactive Simulations for Complex Concepts

At a partner school in Poland, teachers introduced **PhET Interactive Simulations** to explain abstract topics in physics and chemistry. Students who struggled with traditional textbook explanations found the visual, interactive experiments easier to follow. For example, when studying electricity, students could manipulate virtual circuits, bulbs, and resistors. Teachers reported that students with lower prior achievement became more confident in experimenting without fear of "failing."

Impact:

Improved conceptual understanding of physics.

Increased student participation, especially from previously passive learners.

More collaborative peer discussions.

Case Study 2: Robotics Clubs for Hands-On Learning

In North Macedonia, a primary school introduced **LEGO Education WeDo and Scratch** programming

activities after noticing disengagement in mathematics. Students built simple robots and coded them to complete tasks, linking logical reasoning with practical outcomes.

Impact:

Mathematics achievement improved as students applied concepts like measurement, angles, and sequences in coding tasks.

Stronger motivation among students, particularly boys who had been underperforming.

Teachers observed higher problem-solving skills across subjects.

Case Study 3: Cross-Curricular Hologram Projects

In Spain, students worked on **hologram-based STEM projects** where they created 3D visualizations of the solar system using ICT tools. Even students who typically struggled with reading comprehension could visualize planetary motion and present their holograms to peers.

Impact:

Increased confidence in public speaking.

Deeper retention of scientific concepts.

Girls actively took leadership roles in presentation and design.

2. Open Educational Resources (OER) for STEM

Where to Find Them

Teachers can access high-quality free OER platforms that provide adaptable STEM resources. Below are some of the most widely used, with suggestions on how to bring them into primary classrooms.

PhET Interactive Simulations – *University of Colorado Boulder*

https://phet.colorado.edu

PhET offers free interactive simulations in physics, chemistry, biology, earth science, and mathematics. Students can manipulate variables, test hypotheses, and visualize invisible phenomena such as electricity, energy transfer, or molecular motion.

Primary school adaptation: Teachers can simplify simulations by focusing on cause–effect relationships (e.g., "What happens if we add more bulbs to the circuit?").

Use in class: Excellent for inquiry-based learning, science fairs, and flipped classrooms.

CK-12 Foundation

https://www.ck12.org

CK-12 provides free, customizable digital textbooks ("FlexBooks"), simulations, concept maps, and practice exercises in math and science. The platform allows teachers to adapt materials and create class-specific collections.

Primary school adaptation: Simplify complex chapters into visual story-based lessons. Use adaptive practice for individualized learning support.

Use in class: Create a digital "mini textbook" aligned with the school curriculum. Teachers can assign interactive quizzes to track progress.

NASA STEM Engagement

https://www.nasa.gov/stem

NASA offers lesson plans, multimedia resources, interactive challenges, and data directly from real space missions. Topics include astronomy, engineering, earth sciences, and space technology.

Primary school adaptation: Use NASA's videos and AR/VR apps to make abstract space topics (like gravity or planetary motion) engaging.

Use in class: Organize a "Space Week" where students explore NASA experiments and design their own rockets using everyday materials.

Khan Academy

https://www.khanacademy.org

Khan Academy provides thousands of free video lessons, practice problems, and progress tracking across mathematics, science, and computing. Lessons are structured in small, manageable chunks with adaptive feedback.

Primary school adaptation: Use videos to introduce new math concepts and then reinforce with classroom practice.

Use in class: Teachers can assign homework or practice modules for individualized learning. Supports multilingual subtitles, which helps non-native speakers.

OpenStax (Rice University)

https://openstax.org

OpenStax publishes high-quality, peer-reviewed, openly licensed textbooks covering math, physics, biology, and more. Although often used at the secondary and university level, they can be adapted for advanced primary students.

Primary school adaptation: Teachers can take diagrams, worked examples, and summaries and simplify them into worksheets.

Use in class: Use visuals and real-world examples from OpenStax texts to strengthen lesson materials.

OER Commons

https://www.oercommons.org

OER Commons is a large digital library of openly licensed teaching and learning resources across all subjects, including STEM. Teachers can search, filter by grade level, and remix resources for their classrooms.

Primary school adaptation: Filter by primary education and STEM to find age-appropriate activities. Adapt lesson plans to local curriculum.

Use in class: Teachers can share and co-create lesson plans with colleagues across countries, enriching Erasmus+ collaboration.

✅**Teacher Tip:** When using OERs, always check the **Creative Commons license**. Many allow free use and adaptation, but some require attribution or non-commercial use.

How to Adapt for Primary School Use

Simplify language: Adapt text-heavy materials into age-appropriate language with visuals.

Chunk content: Break lessons into smaller, gamified learning activities.

Add real-life connections: For example, instead of abstract equations, use cooking, sports, or playground examples to introduce measurement or force.

Use local context: Incorporate familiar cultural and community examples to make concepts relevant.

Scaffold with ICT: Combine OER with tools like Kahoot or Quizizz for quick checks of understanding.

3. Inclusive ICT Practices

Engaging Students with Different Learning Styles

Visual learners: Use animations, videos, holograms, and infographics.

Auditory learners: Encourage podcast listening, voice recordings, and student-created narrations.

Kinesthetic learners: Introduce robotics kits, AR/VR experiences, and hands-on coding.

Reading/Writing learners: Provide digital journals, blogging platforms, and interactive e-books.

Teachers can combine tools like **Padlet**, **Jamboard**, or **Nearpod** to ensure multiple entry points for all learners.

Encouraging Girls in STEM Through Tech Immersion

Research consistently shows gender gaps in STEM participation. ICT can be a bridge by offering:

Female role models in digital content: Show video interviews or online talks by women scientists and engineers.

Collaborative tech projects: Girls often thrive in teamwork-based ICT projects such as coding games or designing STEM presentations.

Gamified coding platforms: Tools like **Blockly**, **Code.org**, and **Scratch** are non-threatening and allow creativity while learning logic.

Inclusive language and imagery: Ensure resources avoid stereotypes and highlight women's contributions in STEM.

Example from partner schools: In Romania, a school ran a "Girls in Tech" week where female students created simple mobile apps with MIT App Inventor. Participation and interest in technology-related subjects grew, with several students expressing interest in future STEM careers.

Conclusion

ICT-based practices and OER tools provide a rich pathway to address underachievement in STEM subjects. They allow teachers to personalize learning, foster collaboration, and increase engagement across diverse student populations. When carefully adapted to the primary school context, these tools do not only enhance academic outcomes but also promote equity and inclusion—ensuring that all learners, regardless of background or gender, have opportunities to succeed in STEM.

Annex: 24 Preparatory Notes for 40-Minute Classes

As part of this Erasmus+ project, the participating teachers were assigned the task of designing lesson plans that integrate **Open Educational Resources (OER)** and **hologram technology** in STEM teaching. Through collaboration and exchange of ideas across partner schools, they developed innovative classroom activities that combine digital tools with hands-on learning.

The following lesson plans are the result of this joint effort. They are openly shared and can be adapted by any teacher who wishes to teach the same subject or topic, ensuring broader impact and reusability beyond the project schools.

Lesson plan: Food chain (Biology)

<table>
<tr><td>Programming Unit</td><td>Timing</td><td colspan="2">40-60 min.</td><td>Sessions</td><td>1</td></tr>
<tr><td>Education Stage</td><td>Primary</td><td>Year</td><td colspan="3">VII grade</td></tr>
<tr><td colspan="3">Subject</td><td colspan="3">Biology</td></tr>
<tr><td colspan="3">Interdisciplinary relationship between areas</td><td colspan="3">Physics - energy, Geography, Chemistry</td></tr>
<tr><td colspan="6"></td></tr>
<tr><td colspan="3">Learning Situacion</td><td colspan="3">Title: Food chain</td></tr>
<tr><td colspan="3">Education Goals</td><td colspan="3">Students will understand the concept of a food chain and the roles of producers, consumers, and decomposers.
Students will utilize Z Space to visualize and interact with food chain concepts.
Describes how organisms adapt to their habitat, including the interaction of biotic and abiotic factors, looking at examples that occur locally as well as some counterexamples.
Develop a model to describe the movement of matter within an ecosystem, including the relationships among plants, animals, and decomposers
Use the model to describe the cycling of matter among plants, animals, decomposers, and the environment</td></tr>
<tr><td colspan="3">SDG relationship</td><td colspan="3">Goal 3
Ensure healthy lives and promote well-being for all at all ages
Goal 4
Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all
Goal 14
Conserve and sustainably use the oceans, seas and marine resources for sustainable development
Goal 15
Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss</td></tr>
</table>

Basic Knowledge
The **food chain** is a basic concept in ecology that describes the flow of energy and nutrients through an ecosystem. It shows how different organisms are connected based on what they eat and how energy is transferred from one organism to another. Here's the basic knowledge about the food chain: 1. Producers (Autotrophs): 2. Primary Consumers (Herbivores): 3. Secondary Consumers (Carnivores or Omnivores): 4. Tertiary Consumers (Top Carnivores or Apex Predators): 5. Decomposers (Detritivores and Saprotrophs): Flow of Energy: • Energy Flow: Energy flows in one direction—from producers to consumers to decomposers. Each level in the food chain is called a "trophic level." • Energy Loss: As energy flows up the food chain, much of it is lost as heat or used for metabolic processes (e.g., movement, growth), so less energy is available for the next trophic level.

Methodology
Explanation, narrative, descriptive method, dialog, written work, speaking, demonstration, writing method, illustrative, method of practical work, audio-visual.
Grouping

Small group work, whole class, individual work. Heterogeneous Grouping Students are grouped into heterogeneous groups of students with different learning capabilities, skill levels and learning styles. This allows students to interact with different types of students, to learn from one another and to help each other and to practice working in a team. Whole-Class Group Activities After the groups complete their observations and present their findings, the entire class discusses the topic together. This allows students to see different viewpoints and strategies and allows teacher to see how much the students have understood the unit and how much they have learned about the topic.
Didactic sequencing

Resources	Task description

• Students will utilize Z Space to visualize and interact with food chain concepts.	**Introduction (10 minutes)**
	1. **Hook:** Start with a short video or image slideshow of different ecosystems (forest, ocean, desert).
	2. **Discussion:** Ask students to share what they know about food chains. Prompt questions like:
	  ○ What do plants need to survive?
	  ○ Who eats plants?
	  ○ Who eats those animals?
	3. **Introduce Vocabulary:**
	  ○ Producers (plants)
	  ○ Primary Consumers (herbivores)
	  ○ Secondary Consumers (carnivores)
	  ○ Decomposers (fungi, bacteria)
	Direct Instruction (15 minutes)
	1. **Explain the Food Chain:**
	  ○ Draw a simple food chain on the board (e.g., Sun → Grass → Rabbit → Fox → Decomposer).
	  ○ Discuss the flow of energy through the chain and the importance of each role.
	2. **Introduce Z Space:**
	  ○ Explain how Z Space will help visualize and interact with the food chain.
	  ○ Demonstrate the Z Space setup and controls.
	Interactive Activity (20 minutes)
	1. **Z Space Exploration:**
	  ○ Students will pair up and take turns using Z Space to explore a virtual food chain.
	  ○ Assign each pair a specific ecosystem (e.g., rainforest, ocean, tundra) and guide them to create a food chain within that ecosystem.
	  ○ Encourage students to identify at least three producers, two primary consumers, two secondary consumers, and a decomposer.
	Group Discussion (10 minutes)
	1. **Share Findings:**
	  ○ Have students return to the group and share their food chains with the class.
	  ○ Ask each pair to discuss the energy flow in their ecosystem and the importance of each organism.
	2. **Connect to Real Life:**
	  ○ Discuss how human activities can impact food chains (pollution, deforestation, overfishing).
	Conclusion (5 minutes)
	1. **Recap Key Concepts:**
	  ○ Reinforce the definitions of producers, consumers, and decomposers.
	  ○ Conclude that food chains can be used to represent relationships related to nutrition.
	  ○ Discuss the interconnectedness of ecosystems.
	2. **Exit Ticket:**
	  ○ Ask students to write down one new thing they learned about food chains and one question they still have.

Atention to the diversity
Some students prepare a set of maps of their ecosystem and on each map should be written: ☐ name of a living thing and what it eats ☐ consumer, producer or decomposer ☐ herbivore, carnivore, omnivore or detritivore (saprophage) ☐ arrow

Assessment		
Technics	**Activities**	**Instruments**
• Formative assessment, • Summative assesment • Self- assessment	• Participation during discussion and Z Space activity. • Completed worksheets with a drawn food chain specific to their assigned ecosystem. • Exit ticket responses.	• Verbal Feed back information, direct observation • Checklists, • Questionnaires
Plans and programs of the center		
School club "Young biologists", e-tweening club, ECO activities etc.		
Complementary activities		
Visit of experts in environmental issues; visit of activist from ECO NGO's, celebration of planet earth day, etc.		

Lesson plan: Biology, Natural Science

Curricular elements

<table>
<tr><td colspan="3">Programming Unit</td><td>Timing</td><td>80-90 minutes</td><td>Sessions</td><td>2</td></tr>
<tr><td>Education Stage</td><td>PRIMARY</td><td>Year</td><td colspan="4">6TH-7TH GRADE</td></tr>
<tr><td colspan="2">Subject</td><td colspan="5">BIOLOGY/NATURAL SCIENCE/HUMAN AND NATURE</td></tr>
<tr><td colspan="2">Interdisciplinary relationship between areas</td><td colspan="5">Language
Chemistry
Physics</td></tr>
<tr><td colspan="7"></td></tr>
</table>

Basic Knowledge	
• To understand the organization of the human body • To understand and know the parts of the cell • To learn and use specific vocabulary: cell, membrane, organelles, cytoplasm, nucleus.. • Safe and efficient use of ICT	
Education Goals	To learn the parts of the cell. To learn about the function of the cell. To learn the differences between plant and animal cell.
	• Students will utilize Z Space to visualize and interact with animal and plant cell.
SDG relationship	Goal 3: health and wellbeing state Goal 4: Quality education

Methodolgy
Oral explanation Use of ICT Active learning

Grouping
Individual, pairwork and small group

Didactic sequencing	
Resources	**Task description**
Screen /smartboard Laptop Proyector Hologram Hardware Websites Worksheets 3D models Microscope and slices Realia(fresh materials) Students will utilize Z Space to visualize and interact with animal and plant cell	SESSION 1 **1- Make microscope slices with fresh materials (onion)** **2- Recognise the 3 main parts of the plant cell (membrane, cytoplasm and nucleus)** **3- Draw what they see under the microscope and write the parts of the plant cell. Search info about their function (either on the internet or in booklet/cell model in the classroom** SESSION 2 **1- Use the hologram hardware to present the animal cell** **2- Worksheet: cut out and glue an animal cell/3D model using plasticine** **3- Match definition(function) of the parts of the cell in the picture**

Atention to the diversity
Books on the topic for fast finishers Fast finishers can help children that work in a slower way

Assessment		
Technics	**Activities**	**Instruments**

Observation in class Formative assessment	Giving feedback	Check list
Plans and programs of the center		
RED cross activities **Club in schoolBio section jung biologist** **ICT – implementacion of compjuter tehnology**		
Complementary activities		
Talks of experts (children’s relatives...), doctors .		

Lesson plan: Exploring pyramids (Maths, Art, History)

<table>
<tr><td>Programming Unit</td><td>Timing</td><td>40 minutes</td><td>Sessions</td><td>1</td></tr>
<tr><td>Education Stage</td><td>Primary</td><td>Year</td><td colspan="2">IX grade</td></tr>
<tr><td colspan="3">Subject</td><td colspan="2">Maths, arts and history</td></tr>
<tr><td colspan="3">Interdisciplinary relationship between areas</td><td colspan="2">The study of pyramids is a prime example of how mathematics, art, and history can be integrated into a single learning situation. By analyzing the mathematical principles used in pyramid construction, the artistic expression seen in their decoration, and the historical significance of these structures, students gain a deeper understanding of human ingenuity and culture.</td></tr>
<tr><td colspan="5"></td></tr>
<tr><td colspan="3">Learning Situacion</td><td colspan="2">Title: Exploring pyramids</td></tr>
<tr><td colspan="3">Education Goals</td><td colspan="2">1. Understanding Geometric Concepts
Students will learn to identify and describe various geometric shapes, including triangles, squares, and more complex polygons. Through holograms, students can visualize angles, parallel lines, perpendicular lines, and intersecting lines in a three-dimensional space.

2. Developing Spatial Awareness
Holograms can help students develop an understanding of three-dimensional space, making it easier for them to comprehend and manipulate 3D objects.

3. Fostering Creativity and Imagination

Students can use holographic technology to create their own geometric designs or models, fostering creativity.

4. Improving Technological Literacy
Using holograms to teach geometry can also integrate with other subjects such as art, science, and technology, promoting a multidisciplinary approach.

5. Encouraging Collaborative Learning
Students can work in groups to solve geometric problems using holograms, promoting teamwork and communication skills.</td></tr>
</table>

	6. Making Learning Fun and Engaging Holograms provide a dynamic and interactive way of learning that can capture students' interest and make learning more enjoyable. Incorporating games that involve geometry and holograms can motivate students to learn through play.
SDG relationship	Quality Education (SDG 4) Reduced inequalities (SDG 10) Gender equiality (SDG 5)

Methodology
Teacher will organize students into small groups wich allow students to work together, sharing ideas and learning from each other. Each group analyze the geometric principles (angles, proportions, symmetry) used in pyramid design through interactive VR and holographic models.
Grouping
Heterogeneous Grouping Students are grouped with peers of different skill levels, backgrounds, and learning styles. This give stronger students a chance to reinforce their learning by explaining concepts to others, allows students to learn from each other and helps students develop empathy and teamwork skills. **Task-Based Grouping** Groups are formed based on the specific tasks or roles that need to be completed within a lesson or activity. Students need to take on specific roles or responsibilities that requires different tasks (e.g., research, writing, presenting). This encourages teamwork and accountability. **Whole-Class Group Activities** Class discussions and reflection activities are powerful tools for consolidating learning and providing an opportunity for all students to share their perspectives. After students complete a group task, they come back together as a whole class to share their findings and solutions. Every group present their results to the class, with a formal presentation, a simple explanation, or a visual representation. This allows students to see different viewpoints and strategies, reinforcing and expanding their understanding of the material.
Didactic sequencing

Resources	**Task description**
*Whiteboard and markers *Graph paper (for drawing pyramids)	**. Introduction to Pyramids and Their Geometry (5 minutes)** Briefly introduce pyramids and their geometric properties to prepare students for the VR experience.

<table>
<tr>
<td>*Rulers, protractors (for accuracy in drawing shapes)

*Printable pyramid templates (optional for hands-on activity)

*Geometry tools (optional: scissors and glue for 3D pyramid models)

*Projector or screen for teacher demonstration

* Worksheets for students to document their observations

*Zspace software

*zSpace-enabled devices - laptop

*Holographic projections of various pyramids

with zspace</td>
<td>

Ask students: “What do you know about pyramids? Where have you seen them before?, ”

Encourage students to mention the Great Pyramid of Giza and any other pyramids they've encountered in history or pop culture (e.g., in ancient Egypt, Mexico, or popular movies).
Introduce the geometric properties of pyramids: Base, Faces, Vertices, Edges.

Draw a pyramid on the board and label the base, faces, vertices, and edges.

ZSpace Exploration (20 minutes)

Allow students to immerse themselves in a holographic 3D environment of a pyramid, exploring its structure, geometry, and historical context using Zspace technology

Set Up Zspace Stations::

Ensure Zspace is functional with the required stylus
Launch the Zspace software or application that includes ancient Egypt or pyramid-focused 3D models

Instructions for Students:

Students use the stylus to interact with the 3D holographic pyramid model.
Teachers can guide them through zooming in, rotating the structure, and even entering the pyramid (if the model includes internal chambers).

Explore the Pyramid: As students explore, encourage them to look around and notice key features:

The size and scale of the pyramid.
The arrangement of blocks (how the structure is made).
Views from the top, bottom, and interior of the pyramid (if applicable).
The architectural details (e.g., entrance, burial chambers, etc.).

Documentation:

Provide students with a worksheet where they can take notes about what they observe:

Geometric Features: What shapes do they see (triangular faces, square base, etc.)?
Architectural Elements: Any notable design features (entrance, tunnels, interior rooms)?
Historical Significance: What facts about the pyramid did they learn (e.g., how it was built, why it was built)?

Encourage students to write down or discuss the scale of the pyramid, the difficulty of constructing such a massive structure, and any other interesting facts they observe.

Group Discussion and Reflection (5 minutes)

Post- Zspace Discussion:

Once all students have finished their Zspace exploration, gather them together for a class discussion. Ask students:

</td>
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</table>

1. **Geometry**: How did the 3D shapes in the pyramid compare to the 2D shapes we see on paper? What new geometric features did you notice in the pyramid's design? How the Egyptians used their knowledge of geometry to build these immense structures.
2. **Architecture**: What surprised you most about the structure of the pyramid? How do you think the ancient Egyptians built such a monumental structure with limited technology?
3. **Cultural Significance**: Why do you think the pyramid was such an important structure in ancient Egypt? What was its purpose, and how did it reflect their culture and beliefs?

Hands-On Activity: Build a Paper Pyramid Model (10 minutes)

- **Instructions**: Distribute printable pyramid templates. Each student will create a simple model of a pyramid with a square base (or any polygon).
  - Students will:
    1. Cut out the pyramid template.
    2. Fold along the edges to create a 3D pyramid.
    3. Label the parts of the pyramid (base, slant height, apex).
    4. Use colored pencils to decorate the pyramid, representing different materials like stone.
- **Discussion**: As students work, ask them to think about how pyramids can be used in different cultures and how their geometric shape may have been chosen for practical or symbolic reasons.
- **Homework/Extension Ideas**:
  - **Research Assignment**: Ask students to research another famous pyramid (e.g., the **Pyramid of the Sun** in Mexico or the **Step Pyramid** of Djoser) and write a report on its geometry, cultural significance, and construction.

Atention to the diversity

1. Differentiated Instruction

Combining different learning styles like:

- **Visual learners**: Use holograms, animations, and interactive 3D models to explore the properties of pyramids.
- **Auditory learners**: Provide verbal explanations, use storytelling techniques, and encourage group discussions about the significance of pyramids in nature and human-made structures.
- **Kinesthetic learners**: Encourage hands-on activities like creating pyramids from paper to understand properties of pyramids.

The groups are made according to the different abilities of the students which allows leadership roles for some students so they can help and support to each other.

2. Adapted Resources

Break down the steps for understanding pyramids into simpler components for students who may need additional support, starting with the basic definition of a pyramids, focusing on its key characteristics and use step-by-step visual explanations. Provide support through peer tutoring or group work.

3. Inclusive Assessment Techniques

Allowing students to access the content in different formats (audio, visual, kinesthetic) and demonstrating their understanding in various ways (written, verbal, digital).

Students with learning disabilities might need extra time, speech-to-text tools, or alternative formats for written assessments. Offering additional support ensures every student has an equal opportunity to succeed.

Assessment		
Technics	**Activities**	**Instruments**
***Formative**: Monitor students' engagement during the hologram experience. Listen to their observations and questions to gauge understanding. ***Summative**: Evaluate participation in the discussion and the depth of their reflections on the pyramid's geometry and cultural significance. ***Peer Assessment:** Each group give feedback on the effectiveness of the presentations of other groups and how well they communicate their understanding of pyramids geometric properties and historical significance. ***Self assessment**: Help students to understand the basic terms related to pyramid.	**Vocabulary Review:** Highlighting of the basic terms related to pyramid like base, faces, vertices, edges and writing them on white board. **Group Discussion**: In small groups, students exploring pyramids, using ZSpace and discuss the geometry, architecture, and cultural significance of pyramids. **Identification Task**: Each student receives a worksheet where they have take notes about what they observe: geometric features, architectural elements and historical significance. **Group Presentation**: Each group presents their reflect on the hologram exploration and discuss the geometry, architecture, and cultural significance of pyramids. **Hands-On Activity:** Each student need to create a paper pyramid model. After they created the 3D model, they discuss about the differences (base, faces, vertices, edges)	➢ Worksheets ➢ Group presentation ➢ Self – assessment ➢ Peer assessment ➢ Collaborative Discussions
Plans and programs of the center		

Club in school - Math section

ICT – implementacion of compjuter tehnology

Complementary activities
Following a presentation in Prezi Students follow the presentation prepared by the teacher for the integration of maths, hystory and art, using the pyramids. https://prezi.com/p/izeocwlwnyjt/?present=1 **Create a 3D pyramid model** Students use printable pyramid templates, scissors and glue for 3D pyramid model.

<table>
<tr><td>Lesson plan: Exploring spheres (Math, Physics, Geography)Programming Unit</td><td>Timing</td><td colspan="2">40 minutes</td><td>Sessions</td><td>1</td></tr>
<tr><td>Education Stage</td><td>Primary</td><td>Year</td><td colspan="3">IX grade</td></tr>
<tr><td colspan="3">Subject</td><td colspan="3">Maths, Physics and geography</td></tr>
<tr><td colspan="3">Interdisciplinary relationship between areas</td><td colspan="3">The study of spheres ties together mathematical geometry, physical forces (like gravity and rotation), and geographic phenomena (like Earth's shape and climate patterns). By examining spheres through these lenses, students can understand how an abstract mathematical concept extends into the physical world, influencing both the structure of our planet and our interactions with it.</td></tr>
<tr><td colspan="6"></td></tr>
<tr><td colspan="3">Learning Situacion</td><td colspan="3">Title: Exploring spheres</td></tr>
<tr><td colspan="3">Education Goals</td><td colspan="3">3. Understanding Geometric Concepts

Students will grasp the mathematical definition of a sphere as a three-dimensional object. They can describe and manipulate a 3D hologram of a sphere, visualizing its symmetry and uniform curvature from all angles. This will solidify their understanding of the shape and its properties.

4. Developing Spatial Awareness

Holograms can help students develop an understanding of three-dimensional space, making it easier for them to comprehend and manipulate 3D objects.

3. Fostering Creativity and Imagination

Students can use holographic technology to create their own geometric designs or models, fostering creativity.

7. Improving Technological Literacy</td></tr>
</table>

	Using holograms to teach geometry can also integrate with other subjects such as physics, geography, and technology, promoting a multidisciplinary approach. **8. Encouraging Collaborative Learning** Students can work in groups to solve geometric problems using holograms, promoting teamwork and communication skills. **9. Making Learning Fun and Engaging** Holograms provide a dynamic and interactive way of learning that can capture students' interest and make learning more enjoyable. Incorporating games that involve geometry and holograms can motivate students to learn through play.
SDG relationship	Quality Education (SDG 4) Reduced inequalities (SDG 10) Gender equiality (SDG 5)

Methodology
Teacher will organize students into small groups wich allow students to work together, sharing ideas and learning from each other. Each group analyze the geometric properties of a perfect sphere (center, **radius, diameter**, circumference, symmetry) using holographic models.
Grouping
Heterogeneous Grouping Students are grouped with peers of different skill levels, backgrounds, and learning styles. This give stronger students a chance to reinforce their learning by explaining concepts to others, allows students to learn from each other and helps students develop empathy and teamwork skills. **Task-Based Grouping** Groups are formed based on the specific tasks or roles that need to be completed within a lesson or activity. Students need to take on specific roles or responsibilities that requires different tasks (e.g.,

research, writing, presenting). This encourages teamwork and accountability.

Whole-Class Group Activities

Class discussions and reflection activities are powerful tools for consolidating learning and providing an opportunity for all students to share their perspectives. After students complete a group task, they come back together as a whole class to share their findings and solutions. Every group present their results to the class, with a formal presentation, a simple explanation, or a visual representation. This allows students to see different viewpoints and strategies, reinforcing and expanding their understanding of the material.

<table>
<tr><th colspan="2">Didactic sequencing</th></tr>
<tr><th>Resources</th><th>Task description</th></tr>
<tr><td>

***zSpace or Holographic Display System** (for 3D interactive exploration)

***Computer with zSpace or similar 3D software** (if not using a dedicated holographic display)

***3D Models of Earth and Spheres** (can be preloaded or interactive models)

***Projector or Display System** (if not using holograms but still utilizing 3D software)

***Rulers, compasses, and protractors** (for geometric activities)

***Internet Access** (optional for additional resources or simulations)

</td><td>

Introduction (10 minutes):

Begin with a discussion on what a sphere is, asking students to provide examples they see in real life (e.g., basketballs, planets). Show them a physical sphere (e.g., a tennis ball, oranges) and ask students to identify its characteristics. Define a sphere in geometry and discuss the concept of a sphere and its properties.
Ask student: "Is the Earth a perfect sphere?" Prompt them to think about why or why not. Introduce the concept of the oblate spheroid (the shape of Earth). Compare a perfect sphere with the actual shape of planets (such as Earth, Mars, etc.).
Explain that today, students will be using zSpace to explore spheres in 3D. Briefly describe how zSpace works.
Exploration and Explanation (20 minutes)

1. **Geometry of a Sphere**: Use the zSpace system to display a 3D model of a sphere. Zoom in and out, rotate the sphere, and highlight and define important features like the center, radius, **diameter,** circumference and symmetry. Allow students to use the zSpace stylus to manipulate the sphere. Have them rotate it, change its size, and examine it from different angles.

2. **Earth and Other Planets:** Explain that while Earth is often referred to as a "sphere," it is actually an oblate spheroid due to the effects of rotational forces.

- Show a 3D model of Earth with visible polar flattening and equatorial bulging.
- Use zSpace to allow students to manipulate the Earth model and zoom in on the poles and equator to better understand the difference in dimensions also explore the interior of Earth (or another planet), showing layers such as the crust, mantle, outer core, and inner core..
- Discuss the difference between a geometric sphere and the more complex structure of planets, which have atmospheres, magnetic

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	fields, tectonic plates, and internal layers. **3. Exploring Gravitational Forces:** Explain how gravity influences the shape of a planet, making it an oblate spheroid rather than a perfect sphere. ▪ Use interactive simulations in zSpace to demonstrate how planets deform when subjected to rotational forces. Students can change the speed of rotation and observe how it affects the shape. ▪ Allow students to manipulate variables like rotational speed or mass distribution to see the effects on the planet's shape. **Group discussion and Reflection: (5 minutes)** Once all students have finished their exploration, gather them together for a class discussion. Summarize the lesson by reviewing the key properties of spheres. Discuss how the zSpace hologram helped them visualize these concepts in 3D.Discuss how understanding the shape of Earth and other planets is crucial for: ▪ Space exploration (navigation, satellite positioning) ▪ Climate and weather patterns ▪ Understanding gravity and ocean currents **Exit Ticket: (5minutes)** Have each student answer the following question on a piece of paper or digital form: 1. What are the key properties of spheres? 2. Is the Earth a perfect sphere? 3. Explain in your own words how Earth's shape differs from a perfect sphere? 4. Why this difference is important for life on Earth? 5. How did being able to see and manipulate a 3D sphere help you understand its properties better than just looking at a drawing?

Atention to the diversity

1. Differentiated Instruction

Combining different learning styles like:

- **Visual learners**: Use holograms, animations, and interactive 3D models to explore the properties of spheres.
- **Auditory learners**: Provide verbal explanations, use storytelling techniques, and encourage group discussions about the significance of spheres in nature and human-made structures.
- **Kinesthetic learners**: Encourage hands-on activities like creating spheres from clay or paper to understand properties of spheres.

The groups are made according to the different abilities of the students which allows leadership roles for some students so they can help and support to each other.

2. Adapted Resources

Break down the steps for understanding spheres into simpler components for students who may need additional support, starting with the basic definition of a sphere, focusing on its key characteristics and use step-by-step visual explanations. Provide support through peer tutoring or group work.

3. Inclusive Assessment Techniques

Allowing students to access the content in different formats (audio, visual, kinesthetic) and demonstrating their understanding in various ways (written, verbal, digital).

Students with learning disabilities might need extra time, speech-to-text tools, or alternative formats for written assessments. Offering additional support ensures every student has an equal opportunity to succeed.

Assessment		
Technics	**Activities**	**Instruments**
***Formative**: Observe students during the interactive exploration with zSpace to ensure they understand the concepts and are able to manipulate the 3D models effectively. *__Summative__: Evaluate participation in the discussion and the depth of their reflections on the the geometric, physical, and geographic significance of spheres. ***Peer Assessment:** Each group give feedback on the effectiveness of the presentations of other groups and how well they communicate their understanding of the geometric, physical, and geographic significance of spheres. *__Self assessment__: Help students to understand the basic terms related to spheres. **Exit Ticket**: Review the exit ticket responses to assess students' understanding of sphere properties, and the integration of the geometry with physics and geography.	**Vocabulary Review:** Highlighting of the basic terms related to spheres like center, radius, and circumference and writing them on white board. **Group Discussion**: In small groups, students exploring spheres, using zSpace and discuss the geometric, physical, and geographic significance of spheres. **Identification Task**: Each student receives a worksheet where they make notes about what they observe: geometric features, geographic features, and physical changes. **Group Presentation**: Each group presents their reflect on the zSpace exploration and discuss the geometric, physical, and geographic significance of spheres.	➢ Exit ticket ➢ Group presentation ➢ Self – assessment ➢ Peer assessment ➢ Collaborative Discussions

Plans and programs of the center
Club in school - Math section **ICT – implementacion of compjuter tehnology**
Complementary activities
Following a presentation in Prezi Students follow the presentation prepared by the teacher for the integration of maths, physics and geography, using the spheres. https://prezi.com/p/5bg7bejuonhz/?present=1

<table>
<tr><td>Programming Unit</td><td>Timing</td><td colspan="3">80 min.</td><td>Sessions</td><td>2</td></tr>
<tr><td>Education Stage</td><td>Primary</td><td colspan="2">Year</td><td colspan="3">8</td></tr>
<tr><td colspan="3">Subject</td><td colspan="4">Chemistry, Biology, Physics</td></tr>
<tr><td colspan="3">Interdisciplinary relationship between areas</td><td colspan="4">Chemical reactions, such as respiration and photosynthesis, are key to life processes. The conversion of energy in cells, such as how plants convert sunlight into chemical energy, involves chemical changes. Chemical reactions often involve the release or absorption of energy, as seen in exothermic (release of energy) or endothermic (absorption of energy) reactions. Understanding these energy changes links chemistry with physics, particularly thermodynamics.</td></tr>
<tr><td colspan="7"></td></tr>
<tr><td colspan="3">Learning Situacion</td><td colspan="4">Title: Chemical changes of substances</td></tr>
<tr><td colspan="3">Education Goals</td><td colspan="4">1. Understanding Chemical Changes:
Students will understand the concept of a chemical change and be able to differentiate it from a physical change.

2. Recognizing Indicators of Chemical Changes

Students will identify the observable signs of chemical reactions, such as color changes, temperature changes, gas production, and the formation of a precipitate.

3. Explore Chemical Reactions in a Virtual Environment:

Students will use zSpace to virtually explore and conduct chemical experiments in a safe, interactive environment. Using zSpace, students will simulate various chemical reactions, observe the changes, and document their findings.

4. Collaboration and Communication:

Students will collaborate in small groups to discuss and present their findings on chemical changes.

5. Connecting Chemistry to Everyday Life:

Students will relate chemical changes to everyday life and the natural world.</td></tr>
</table>

SDG relationship	Good health and well-being (SDG 3) Responsible consumption and production (SDG 12)

Basic Knowledge
Physical changes of the substance
Methodology
Cooperative / collaborative learning Students will work in small groups. Each group will be engaged with a zSpace simulation to conduct virtual chemical experiments (e.g., combining substances to observe reactions) and will document changes and identify the indicators of chemical reactions. After that the groups will discuss their observations and share findings. Active methodologies: illustration, demonstration, practical work
Grouping
• **Heterogeneous Grouping** Students are grouped into heterogeneous groups of students with different learning capabilities, skill levels and learning styles. This allows students to interact with different types of students, to learn from one another and to help each other and to practice working in a team. • **Whole-Class Group Activities** After the groups complete their observations and present their findings, the entire class discusses the topic together. This allows students to see different viewpoints and strategies and allows teacher to see how much the students have understood the unit and how much they have learned about the topic.
Didactic sequencing

Resources	**Task description**
• Computers or tablets with zSpace access • Projector or screen for group discussion • Whiteboard and markers • Student notebooks for observations and	**Session 1** **1. Introduction to Chemical Changes (10 minutes)** Ask students if they've ever observed a substance changing into something new, like food cooking, an apple turning brown, or metal rusting. **Discussion:** Explain that a **chemical change** occurs when a substance

reflections • Handouts with key terms and vocabulary (optional)	undergoes a transformation that produces a new substance with different properties. Key signs of a chemical change include: -Change in color -Formation of a gas (bubbles) - Appearance of smoke and flame -Formation of a precipitate (solid) Write these signs on the board. **2. Introduction to zSpace Simulation (10 minutes)** **Demonstrate:** Show students how to use zSpace to explore chemical changes. Explain how they can interact with 3D models and simulations to observe chemical reactions. **Interactive Exploration:** Allow students to explore simple 3D simulations on zSpace. Examples may include: -Combining vinegar and baking soda -Burning wood or paper and noting the changes. -Observing iron rusting when exposed to water and oxygen. Ensure students are aware they can rotate, zoom in, and manipulate the models to view reactions from different angles. **3. Guided Practice with zSpace (20 minutes)** **Activity:** In small groups, students will use zSpace to explore several chemical reactions. They will document their observations and focus on identifying the signs of chemical change. **Tasks:** -Observe the reaction between vinegar and baking soda. -Watch the process of rust forming on iron. -Study the combustion of a match or wood. As they work, guide the students to focus on the following questions: -What do you observe during the reaction? -Are there any changes in the color, temperature, or shape of the substance? -What do you think is happening at the molecular level? **Session 2** **1. Independent Practice (10 minutes)** The students continue to practice using zSpace and they write down their observations and identify the signs of chemical change. **2. Creating presentations in Prezi (20 minutes)** The students will make presentations in Prezi in groups about their research on the chemical change of substances E.g. https://prezi.com/view/NwuL8OGdEq3pBlUzH3S2/?fbclid=IwY2xjawKMWOp

	[leHRuA2FlbQlxMABicmlkETF3dDVYbGEyVHdDUGo5S1p1AR7YuUbefk10hhoEr7OH9griM2yrGiXfSWNM8StVOqWD2lWaZyOapst6bdYGPg_aem_CptClFtKKXGNwgp5MnXdlA]() **3. Discussion and Reflection (10 minutes)** **Class Discussion:** The class discuss their findings Ask questions such as: - What are some examples of chemical changes you observed? - How can you tell when a chemical change is occurring? - Can you think of other examples of chemical changes in daily life? Encourage students to share their observations and thoughts on the zSpace experience

Atention to the diversity

The students are grouped in heterogeneous groups, the groups consist of students with varying abilities and knowledge levels.

Assessment

Technics	Activities	Instruments
• **Formative**: Monitorig students as they work, to see how well they are progressing with their assignments, asking questions • **Summative**: Evaluate the participation of the students in the activities and their achievement • **Self-assessment**: Students evaluate their work • **Peer assessment:** Students give feedback on each other's work	• **Presentations in Prezi: Groups are making presentations** in Prezi about the chemical changes of substances. • **Group Presentation: Each group presents their observations and shares their findings with other groups** • **Class Discussion**: Students discuss their observations and findings	• Collaborative Discussions • Direct Observation • Self-assessment • Peer assessment • Group presentation

Plans and programs of the center

- School chemistry club
- ECO club in the school
- ICT – implementacion of compjuter tehnology

Complementary activities

- The students watch educational videos on Acid rain and discuss the videos they watched, for example:

  https://www.youtube.com/watch?v=x49BtB5dOwg

- The students visit local pizzerias and bakeries to see how chemical changes occur in substances when making pizzas, pastries, cakes, etc.

Programming Unit	**Timing**	40 min.		**Sessions**	1
Education Stage	Primary	**Year**	8		

Subject	Chemistry, Biology, Geography, Environmental Science
Interdisciplinary relationship between areas	**Acid rain** is rain that's more acidic than normal because it mixes with pollutants in the air. It can hurt plants, animals, buildings, and even human health. It is a multidisciplinary problem that requires an integrated approach across various fields such as environmental science, chemistry,biology, geography etc. By understanding acid rain and how it forms, we can make better choices to protect the environment.
Learning Situacion	Title: Acid rain
Education Goals	**1. Understanding the Concept of Acid Rain:** Students will be able to define acid rain and explain how it forms. **2. Visualizing the Formation of Acid Rain:** Students will have a visual understanding of the chemical process behind acid rain formation, illustrating the conversion of pollutants into sulfuric and nitric acid. **3. Exploring the Environmental Impact of Acid Rain:** Students will immerse in a virtual environment where they can see the effects of acid rain on forest health, soil pH, and the survival of aquatic organisms. **4. Collaboration and Communication:** Students will collaborate in small groups to discuss about possible sollutions to prevent air pollution. **5. Promoting Critical Thinking and Problem-**

	Solving: Students will engage in problem-solving activities using zSpace, they will analyze the causes and effects of acid rain and try to find sollution to the problem.
SDG relationship	Good health and well-being (SDG 3) Clean water and sanitation (SDG 6) Sustainable cities and communities (SDG 11) Climate action (SDG 13) Life below water (SDG 14) Life on land (SDG 15)

Basic Knowledge

Pollution and Human Activities

Methodology

Cooperative / collaborative learning

Students will work in small groups. Each group will immerse in a virtual environment where they can see the effects of acid rain on forest health, soil pH, and the survival of aquatic organisms. They will analyze the causes and effects of acid rain and try to find sollution to the problem.

Active methodologies: illustration, demonstration, practical work

Grouping

- **Heterogeneous Grouping**

Students are grouped into heterogeneous groups of students with different learning capabilities, skill levels and learning styles. This allows students to interact with different types of students, to learn from one another and to help each other and to practice working in a team.

- **Whole-Class Group Activities**

After the groups complete their observations and present their findings, the entire class discusses the topic together. This allows students to see different viewpoints and strategies and allows teacher to see how much the students have understood the unit and how much they have learned about the

topic.	
Didactic sequencing	
Resources	**Task description**
• Computers or tablets with zSpace access • Projector or screen for group discussion • Whiteboard and markers • Student notebooks for observations and reflections • Handouts with key terms and vocabulary (optional)	**1. Introduction to Acid Rain (10 minutes)** **Ask the students**: "What do you think happens when rain falls from the sky, and it's not just water?" This will lead to a discussion on the different types of rain. **Define Acid Rain**: Explain acid rain as rain that is more acidic than normal rain due to pollutants in the air (primarily sulfur dioxide (SO_2) and nitrogen oxides (NO_x)). **2. zSpace Interactive Activity (20 minutes)** **Introduction to zSpace**: **E**xplain to the students how to use zSpace to interact with a 3D model of the Earth's atmosphere and the formation of acid rain. **Guided zSpace Simulation**: - **Step 1**: Use the zSpace environment to explore the Earth's atmosphere. Guide students to locate the pollutants in the air—sulfur dioxide (SO_2) and nitrogen oxides (NO_x). Show how these pollutants mix with water vapor, oxygen, and other elements to form sulfuric acid (H_2SO_4) and nitric acid (HNO_3). - **Step 2**: Let students interact with the model to observe how the acids descend through the atmosphere and eventually combine with water droplets to create acid rain. - **Step 3**: Explore the effects of acid rain on different environments. Have students use zSpace to view models of trees, lakes, buildings, and soil affected by acid rain. Discuss how acid rain can damage plant life, aquatic ecosystems, and human-made structures like buildings and statues. **3. Discussion & Reflection (10 minutes)** **Class Discussion**: The students discuss their observations from the zSpace simulation. Ask questions such as: - What did they find most surprising about acid rain? - What are some real-world examples of acid rain (e.g., the damage to buildings, the decline of fish populations in lakes)? Discuss possible solutions: - How can we reduce acid rain? - What actions can industries or individuals take to prevent air pollution?

	Homework/Extension Ideas: **Hands-On Activity** The students are divided into groups, each group makes a presentation about their research on acid rain. They can use either paper or digital tools (e.g., Google Slides or Canva): https://www.canva.com/design/DAGldjs9sQ0/_6Djq5MFda2TGCbARu0Org/view?utm_content=DAGldjs9sQ0&utm_campaign=designshare&utm_medium=link2&utm_source=uniquelinks&utlId=hc39c139b8d&fbclid=IwY2xjawKgW3pleHRuA2FlbQIxMABicmlkETFyN3p4Q1FZVkdzMjhiR0VhAR49Z4oBuQGkXwhhin5kC1bWiHpBwy3BQohKT_ZNHQgZMnrWEcCnyPE3yDt60g_aem_SnYIskppu6GIb5TNUStRuw#7

Atention to the diversity

The students are grouped in heterogeneous groups, the groups consist of students with varying abilities and knowledge levels.

Assessment

Technics	Activities	Instruments
• **Formative**: Observinig students during the zSpace activity, to see how well they are progressing with their assignments, asking questions • **Summative**: Evaluate the participation of the students in the activities and their achievement • **Peer assessment:** Students give feedback on each other's work	• **Hands-On Activity:** Students will create a presentations about their research on acid rain. • **Group Presentation: Each group presents their observations and shares their findings with other groups** • **Class Discussion**: Students share their observations from the zSpace simulation and posible solutions to prevent air pollution	• Collaborative Discussions • Direct Observation • Worksheets • Group presentation • Peer assessment

Plans and programs of the center

- School chemistry club
- ECO club in the school
- ICT – implementacion of compjuter tehnology

Complementary activities
• The students watch educational videos on Acid rain and discuss the videos they watched, for example: https://www.youtube.com/watch?v=1PDjVDIrFec • The students invite representatives from local environmental associations and discuss with them the consequences of acid rain

<table>
<tr><td>Programming Unit</td><td>Timing</td><td colspan="3">40</td><td>Sessions</td><td>1</td></tr>
<tr><td>Education Stage</td><td>Primary</td><td>Year</td><td colspan="4">Year 6</td></tr>
<tr><td colspan="3">Subject</td><td colspan="4">Physics, Geography and History</td></tr>
<tr><td colspan="3">Interdisciplinary relationship between areas</td><td colspan="4">This learning situation is connected with geography and history. Gravity plays a key role in shaping the planet's landscape, climate, and even the movement of objects within the atmosphere. Gravity has been a subject of study for centuries, and learning about how people like Newton and Einstein developed their theories about gravity, gives you a historical context for its scientific development.</td></tr>
<tr><td colspan="7"></td></tr>
<tr><td colspan="3">Learning Situacion</td><td colspan="4">Title: Gravity</td></tr>
<tr><td colspan="3">Education Goals</td><td colspan="4">1. Understand the concept of gravity and how it affects objects.
Students will understend the basic idea of gravity and recognize how it influences the behavior and movement of objects.
2. Identify the force of gravity in different scenarios.
Students will determine the gravitational force acting on an object under various conditions. This can involve calculating how the force of gravity changes depending on factors such as the mass of objects, the distance between them, and the environment in which they exist.
3. Use ZSpace to visualize gravity in an interactive 3D environment.
Students will visualize and explore the concept of gravity in three dimensions.
4. Demonstrate the impact of gravity on motion and weight.
Students will show how gravity influences the way objects move and how much they weigh.</td></tr>
<tr><td colspan="3">SDG relationship</td><td colspan="4">Quality education (SDG 4)</td></tr>
</table>

Programming Unit	**Timing**	40	**Sessions**	1

Education Stage	Primary	Year	6
Subject			Physics, Astronomy
Interdisciplinary relationship between areas			This learning situation is connected with Astronomy. The Solar System is a foundational part of astronomy, and studying it gives you an excellent entry point into broader concepts in space science.
Learning Situacion			**Title:** Solar System
Education Goals			1. **Identify and describe the eight planets in the Solar System.** The students will recognize the eight planets that orbit the Sun 2. **Understand the relative sizes, distances, and characteristics of the planets.** Students will identify and acknowledge the eight major celestial bodies in our Solar System. 3. **Engage with 3D models of the Solar System using zSpace to enhance spatial understanding.** Students will explore and learn about the Solar System through three-dimensional (3D) models. 4. **Recognize the concept of orbits and the relationship between the Sun, planets, and other objects in the solar system.** Students will understanding how objects in space, like planets, moons, asteroids, and comets, move around the Sun in defined paths called orbits.
SDG relationship			Quality education (SDG 4)

Basic Knowledge
Introduction to the Solar System, Planets and Their Characteristics, Moon and Other Natural Satellites, Other Solar System Objects
Methodology

Cooperative / collaborative learning

Organizing students into small groups will allow students to work together and share their findings and discuss their understanding of Solar System with one another, reinforcing their learning.

Grouping

Heterogeneous Grouping

Students are grouped with peers of different skill levels, backgrounds, and learning styles. This give stronger students a chance to reinforce their learning by explaining concepts to others, allows students to learn from each other and helps students develop empathy and teamwork skills.

Task-Based Grouping

Groups are formed based on the specific tasks or roles that need to be completed within a lesson or activity. Students need to take on specific roles or responsibilities that requires different tasks (e.g., research, writing, presenting). This encourages teamwork and accountability.

Whole-Class Group Activities

Class discussions and reflection activities are powerful tools for consolidating learning and providing an opportunity for all students to share their perspectives. After students complete a group task, they come back together as a whole class to share their findings and solutions. Every group present their results to the class, with a formal presentation, a simple explanation, or a visual representation. This allows students to see different viewpoints and strategies, reinforcing and expanding their understanding of the material.

Didactic sequencing

Resources	Task description
zSpace software Handouts with planetary facts and fun trivia Interactive Solar System diagram for projection Whiteboard and markers	**1. Introduction (5 minutes)** Introduce the Solar System and set context for the zSpace exploration. Discussion: Begin by asking students what they already know about the Solar System. What is the Solar System? Can they name any of the planets? What do they think makes each planet unique? Presentation: Show an overview of the Solar System, either on a projector or using a physical model. **2. Exploration with zSpace (20 minutes)** Students will explore the Solar System interactively using zSpace technology. Divide the class into small groups. Show students how to use the zSpace tools to interact with the Solar System: Select a planet to view in 3D. Zoom in and out to explore the planets from different angles.

	Click on different features (e.g., Saturn's rings, Jupiter's Great Red Spot, or Earth's Moon). Compare sizes and distances between planets. Encourage students to: Rotate planets, zoom in on moons, and look at planetary atmospheres. Read about specific features of planets (like the gas giant composition, the volcanic surface of Venus, or the icy rings of Saturn). Students can take notes or screenshots of interesting features they encounter. **3. Guided Worksheet Activity (10minutes)** Reinforce learning by applying knowledge gained from the exploration. Worksheet: Distribute a worksheet with questions that encourage both recall and deeper thinking. **4. Group Discussion and Recap (5 minutes)** Review key concepts and address any questions or misconceptions. Have students share some of the interesting things they learned or noticed during their exploration. Ask a few students to present facts about the planets they researched. Discuss the differences between the inner and outer planets.

Attention to the diversity
The students are grouped in heterogeneous groups, the groups consist of students with varying abilities and knowledge levels.

Programming Unit	Timing	60 min	Sessions	2
Education Stage	Primary	Year	6th -7th grade	
Subject			Biology	
Interdisciplinary relationship between areas			Language Physics	
Learning Situation			How does our body work?	
Education Goals			To know how our body works and the importance of each body system	

Assessment		
Technics	**Activities**	**Instruments**
Formative assessment Peer-Assessment Self-Assessment	Creating a presentation or demonstration	Direct observation

Plans and programs of the center

- The lesson supports the annual teaching program for Physics (Natural Sciences).
- Follows the guidelines of the Ministry of Education for thematic units related to Solar System.
- It supports the development of students' understanding of space (the Solar System).
- Encourages interdisciplinary learning and development of key competencies (e.g., communication, collaboration, digital literacy).
- Promotes curiosity and awareness of Earth's place in the universe.

Complementary activities

Create a Solar System Model
Students use paper, clay, or recycled materials to build a 3D model of the Solar System.

Solar System Poster
In groups, students make a poster showing the planets, their order, size, and characteristics.

Watch a Short Video
Watch a National Geographic video about the planets, then discuss what they learned

SDG relationship	Goal 3: Ensure healthy lives and promote well-being for all at all ages. Goal 4 Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.

Basic Knowledge
-To understand how the body works as a result of the combination of different systems involved. -To understand the basic function of each body system. -To know the importance of taking care of our body

Methodology
Oral explanation Use of ICT -Active learning -Experiential learning

Grouping
Pair-work, small group work, whole class...

Didactic sequencing	
Resources	Task description
Screen /smartboard Laptop Projector Hologram Hardware Websites 3D models Videos	SESSION 1: -Worksheet to classify different organs according to the system they belong to. -Use of holograms and VR glasses to know in more detail about these systems (how they are distributed within the system they belong to and inside the body) SESSION 2: -In small groups, they prepare a brief presentation about the system they have been assigned. We provide with with a laptop. They log into a canva template and they will have to complete it with the information required. In that presentation they can include images, videos or links to support the information in the presentation.

Atention to the diversity

Groups will be distributed in a heterogeneous way, so that weaker students can get support from more talented pupils. Apart from that,we will take into account socio-emotional characteristics when creating the groups. This way, we will make sure that students with lower social abilities receive the support needed to overcome the presentation in a successful way. We have to make sure that all students have a important role within the group, that is, that no student is left behind. In order to achieve this, we will have to monitor and check that groups are working properly.

Assessment		
Technics	Activities	Instruments
Formative assessment Summative Peer-Assessment Self-Assessment	-Involvement in the ZSpace and VR glasses activity. -Canva presentation	Verbal Feed back information, direct observation Rubric
Plans and programs of the center		
ECO Project		
Complementary activities		
Talks of experts (children's relatives who work on this area)		

Programming Unit			Timing	80-90 minutes	Sessions	1-2
Education Stage	Primary education	Year	12			
Subject		**Exploring Physical Changes of Substances with Holograms: A Path to Sustainable Solutions!**				
Interdisciplinary relationship between areas		English language Technology				

Learning Situacion	**Geometry around us: exploring shapes and space with holograms.**
Education Goals	Identify and describe the physical changes of substances (melting, freezing, sublimation, evaporation, condensation). Understand how these changes affect natural resources and everyday life. **3.**Interactively explore physical changes using holograms to visualize processes in a clearer and more dynamic way. **4.** To promote a responsible attitude towards science and the environment.
SDG relationship	• Responsible consumption and production (**SDG 12)** • Climate action (**SDG13)**

Methodolgy

Cooperative methodology

By working in small groups, students actively collaborate to explore physical changes and relate these concepts to everyday situations using holographic technology. Each group member can take on different roles—such as manipulating holograms or solving problems—which encourages responsibility and allows for diverse contributions within the team.

Grouping

We are going to use differents groupings

1. **Heterogeneous Grouping**

- **Mixed Abilities**: Students are grouped to ensure a mix of abilities, balancing strong math skills with those who may need additional support. This allows for peer mentoring, as students can learn from one another, discuss concepts collaboratively, and share diverse perspectives.
- **Diverse Learning Styles**: Groups are created to include students with varied learning preferences (visual, auditory, kinesthetic), so they can approach tasks from multiple angles, with each student contributing their strengths.

2. **Flexible Grouping**

- **Adaptable to Task Requirements**: Depending on the activity, grouping size and composition may vary (e.g., larger groups for brainstorming sessions, smaller groups for hands-on tasks), allowing students to engage in both large and intimate settings.

3. **Role-Based Grouping**

- **Assigned Roles**: Within each group, students take on specific roles, such as *Reporter*, *Recorder*, *Spokersperson*, or *Researcher*.

4. **Whole-Class Group Activities**

- **Class Discussions and Reflection**: After group tasks, the entire class comes together to discuss findings, ensuring that all students hear different perspectives and understandings. This whole group setting reinforces concepts learned in smaller groups and allows students to share their experiences.

5. **Evaluation of Group Dynamics**

- **Teacher Reflections**: Adjustments are made as needed to support collaboration and effective group work.
- **Self and Peer Evaluation**: Students reflect on their roles and contributions within groups, giving feedback on how well the group worked together, which fosters awareness of their collaboration skills and areas for improvement.

Didactic sequencing

Resources	Task description
Digital whiteboard Zspace software	**Session 1. Knowing key concepts** It begins with a general explanation of the physical changes (defining concepts such as melting, freezing, evaporation, and condensation). Relate these concepts to everyday situations, such as water going from solid to liquid, or from liquid to gas, to help students better understand the processes. We'll use holograms to show these processes visually. For example, have students see a hologram of water going from solid (ice) to liquid (water) and then to gas (vapor). This will make the concepts clearer and more engaging. Group assignment in which students use handouts to identify changes in substances, using holograms to support their observations. **Session 2. Exploring changes** Use holograms to represent science experiments that show physical changes. For example:

Physical models or simple experiments on physical changes (water, ice, steam). Zspace software.	
Digital whiteboard Zspace software Posters or visual resources on SDGs 12 and 13.	Fusion: A hologram of a piece of ice melting into water. Evaporation: Shows hot water turning into steam. Condensation: Water vapor turning back into water droplets on a cold surface. Students can interact with the holograms, asking questions such as: What happens if we heat the ice up? What do you see?" "Can we change the speed of melting ice by changing the temperature?" In this task, students will interact with holograms of various prisms, identify their properties, and work in groups to compare and classify these prisms based on their characteristics. Students will use these holograms as visual aids to deepen their understanding of geometric concepts. **Session 3:** It introduces the concept of SDGs and explores how the physical changes of substances are related to sustainability and care for the planet. SDG 12: Responsible Consumption and Production: Discusses how physical changes can be relevant in recycling (e.g. how glass and plastic can be recycled through physical changes) and how this knowledge can help reduce unnecessary resource consumption.
Digital whiteboard Zspace software	Practical example: "By understanding how materials change, we can make smarter choices about recycling and reusing resources." SDG 13: Climate Action: Connects the science of physical change with climate change, especially in phenomena such as melting glaciers and evaporation from the oceans. Practical example: "The melting of glaciers due to temperature changes is a physical change. Can you think of how that impacts our climate?" **Session 4: Effects of climate change** Use graphs and holograms that show the effects of climate change, such as shrinking glaciers and rising sea levels, to illustrate how physical changes are part of the environmental issues we need to address. Students can share their ideas about how physical changes can be applied to environmental problem solving. Form small groups where students discuss and propose sustainable solutions.
Atention to the diversity	

1. Differentiated Instruction

- Lessons incorporate visual (holographic displays), auditory (group discussions and explanations), and kinesthetic (hands-on tasks with manipulatives) methods, catering to different learning preferences.
- Students are grouped based on mixed abilities, allowing peers to support each other. Advanced students can be given leadership roles, while those who may need additional help receive peer support.

2. Adapted Resources

- For students who may need additional support, simplified worksheets and visual aids are provided to help them understand concepts at their own pace.

3. Inclusive Assessment Techniques

- Observations, oral assessments, and group evaluations provide multiple ways for students to demonstrate their knowledge.
- Students reflect on their understanding, providing insight into their own progress and comfort level.

Assessment		
Technics	**Activities**	**Instruments**
Questioning: Using open-ended questions. **Self-Assessment**: Help students to reflect on their understanding of physical changes os substances **Peer Assessment**: Students give feedback on each other's observations, aiding active listening and critical thinking. **Performance Assessment**: Evaluate students' ability to describe tehe changesbof substances **Written Assessment**: Short quizzes to check for understanding of specific properties.	**Vocabulary Review**: Students complete a vocabulary sheet, identifying edges, faces, and vertices for each shape viewed in holograms. **Group Discussion**:In small groups, students discuss how physical changes in substances are related to sustainability and caring for the planet. **Group presentation**: Each group presents an experiment where different changes that occur in the type substances are appreciated, explaining their characteristics and properties	• **Checklist** • **Self-assessment worksheet on their own learning**

Plans and programs of the center
Digital Plan: The use of holographic technology aligns with the center's commitment to integrating innovative educational tools. Which help to familiarizes them with emerging technologies.

Complementary activities

<table>
<tr><td colspan="3">Programming Unit</td><td>Timing</td><td>80-90 minutes</td><td>Sessions</td><td>1-2</td></tr>
<tr><td>Education Stage</td><td>Primary education</td><td>Year</td><td colspan="4">Year 6</td></tr>
<tr><td colspan="3">Subject</td><td colspan="4">Maths and arts and crafts.</td></tr>
<tr><td colspan="3">Interdisciplinary relationship between areas</td><td colspan="4">This learning situation is connected with other subjects like arts and crafts. Concretely with symmetry and designs because students are learning to observe and create geometric patterns, which connects maths to visual arts and allows them to explore different aspects of geometry.
Also, it is related with 3d modeling because, they are exploring geometry in all its forms.</td></tr>
<tr><td colspan="7"></td></tr>
<tr><td colspan="3">Learning Situacion</td><td colspan="4">Geometry around us: exploring shapes and space with holograms.</td></tr>
<tr><td colspan="3">Education Goals</td><td colspan="4">1. Understanding Geometric Concepts

Through holograms, students can visualize angles, perpendicular lines, parallel lines and intersecting lines in a three-dimensional space.

2. Developing Spatial Awareness:

Holograms will help students to develop an understanding of three-dimensional space, making it easier for them to comprehend and manipulate 3D objects.

Visualizing rotations, translations, and reflections in a 3D space helps students understand these transformations better.

3. Encouraging Collaborative Learning

Students can work in groups to solve geometric problems using holograms, promoting teamwork and communication skills.

Interactive holograms can be used to facilitate class discussions about geometric concepts and their applications.

4. Making Learning Fun

• Interactive Learning: Holograms provide a dynamic and interactive way of learning that can capture students' interest and make learning more enjoyable.</td></tr>
<tr><td colspan="3"></td><td colspan="4">• Gamification: Incorporating games that involve geometry and holograms can motivate students to learn through play.</td></tr>
</table>

SDG relationship	Quality Education **(SDG 4)** Reduced inequalities **(SDG 10)** Gender equiality **(SDG 5)**

Methodolgy

Cooperative methodology

By working in small groups, students actively collaborate to explore geometric concepts such as 3D shapes, transformations, symmetry, and spatial relationships using holographic technology. Each group member can take on different roles—such as manipulating holograms or solving problems—which encourages responsibility and allows for diverse contributions within the team.

Grouping

We are going to use differents groupings

1. **Heterogeneous Grouping**

- **Mixed Abilities**: Students are grouped to ensure a mix of abilities, balancing strong math skills with those who may need additional support. This allows for peer mentoring, as students can learn from one another, discuss concepts collaboratively, and share diverse perspectives.
- **Diverse Learning Styles**: Groups are created to include students with varied learning preferences (visual, auditory, kinesthetic), so they can approach tasks from multiple angles, with each student contributing their strengths.

2. **Flexible Grouping**

- **Adaptable to Task Requirements**: Depending on the activity, grouping size and composition may vary (e.g., larger groups for brainstorming sessions, smaller groups for hands-on tasks), allowing students to engage in both large and intimate settings.

3. **Role-Based Grouping**

- **Assigned Roles**: Within each group, students take on specific roles, such as *Reporter*, *Recorder*, *Spokersperson*, or *Researcher*.

4. **Whole-Class Group Activities**

- **Class Discussions and Reflection**: After group tasks, the entire class comes together to discuss findings, ensuring that all students hear different perspectives and understandings. This whole group setting reinforces concepts learned in smaller groups and allows students to share their experiences.

5. **Evaluation of Group Dynamics**

- **Teacher Reflections**: Adjustments are made as needed to support collaboration and effective group work.
- **Self and Peer Evaluation**: Students reflect on their roles and contributions within groups, giving feedback on how well the group worked together, which fosters awareness of their collaboration skills and areas for improvement.

Didactic sequencing

Resources	**Task description**

Zspace software Cross wordlabs	**Session 1. What is geometry?** Introduce 3D shapes using holograms, allowing students to observe and discuss differences between 2D and 3D shapes. Group task where students use handouts to identify each shape's properties, using holograms to support their observations. Conclude with class discussion to clarify vocabulary.
Holographic projections of various prisms with zspace Geometry worksheets with diagrams of prisms.	**Session 2. Exploring Prisms** In this task, students will interact with holograms of various prisms, identify their properties, and work in groups to compare and classify these prisms based on their characteristics. Students will use these holograms as visual aids to deepen their understanding of geometric concepts.

Atention to the diversity

1. Differentiated Instruction

- Lessons incorporate visual (holographic displays), auditory (group discussions and explanations), and kinesthetic (hands-on tasks with manipulatives) methods, catering to different learning preferences.
- Students are grouped based on mixed abilities, allowing peers to support each other. Advanced students can be given leadership roles, while those who may need additional help receive peer support.

2. Adapted Resources

- For students who may need additional support, simplified worksheets and visual aids are provided to help them understand concepts at their own pace.

3. Inclusive Assessment Techniques

- Observations, oral assessments, and group evaluations provide multiple ways for students to demonstrate their knowledge.
- Students reflect on their understanding, providing insight into their own progress and comfort level.

Assessment

Technics	Activities	Instruments
Questioning: Using open-ended questions. **Self-Assessment**: Help students to reflect on their understanding of 3D shapes and properties. **Peer Assessment**: Students give feedback on each other's observations, aiding active listening and critical thinking. **Performance Assessment**: Evaluate students' ability to classify and describe properties of different prisms. **Written Assessment**: Short quizzes to check for understanding of specific properties.	**Vocabulary Review**: Students complete a vocabulary sheet, identifying edges, faces, and vertices for each shape viewed in holograms. **Group Discussion**: In small groups, students discuss observations about each shape's properties, then present key points to the class. **Identification Task**: Each student receives a worksheet with illustrations of 3D shapes. They identify each shape and label its edges, faces, and vertices. **Classification Task**: Students classify various 3D shapes of prisms and identify their characteristics. G**roup Presentation**: Each group presents one type of prism to the class, explaining its characteristics and properties. **Quiz**: A short quiz on prisms that includes questions about identifying properties, classifying shapes, and counting edges, faces, and vertices.	• **Checklist** • **Worksheet** • **Self-Assessment For** • **Classification Worksheet** • **Quiz**
Plans and programs of the center		
Digital Plan: The use of holographic technology aligns with the center's commitment to integrating innovative educational tools. Which help to familiarizes them with emerging technologies.		
Complementary activities		

Lesson plan: What are the plant tissues and their functions? (Biology, Natural Science)

Programming Unit		Timing	40 minutes	Sessions	1
Education Stage	PRIMARY	Year	6th - 7th GRADE		
Subject		BIOLOGY/NATURAL SCIENCE/HUMAN AND NATURE			
Interdisciplinary relationship between areas		Language Chemistry Physics			
Learning Situacion		What are the plant tissues and their functions?			
Education Goals		To find out and understand what is tissue. To learn about the tissues of plants. To learn about the function of the plant tissues.			
SDG relationship		Goal 3: Health and wellbeing state Goal 4: Quality education			

Curricular elements

Basic Knowledge

- To understand the organization of the plants.
- To understand each tissue where it is located.
- To understand and know the tissues of plants.
- To learn and use specific vocabulary: cell, tissues.
- Safe and efficient use of ICT

Methodolgy

Oral explanation

Use of ICT

Active learning

Grouping

Individual work, and working in small groups of two or three.

Didactic sequencing	
Resources	**Task description**

Programming Unit	Timing		Sessions	6

Screen /smartboard Laptop Projector Hologram Hardware Websites Microscope Realia (fresh materials)	SESSION 1 **4- Microscopic observation of plant tissues. Make microscope slices with fresh materials;** **5- Recognition of plant tissues (formative, basic, covering, conductive, mechanical);** **6- Draw what they see under the microscope and identify which plant tissue they see. Search info about their function (either on the Internet or in booklet);** **4- Usage of hologram hardware to present the plant tissues.**

Atention to the diversity
Books on the topic for fast learners. Fast finishers can help children that work in a slower way.

Assessment		
Technics	**Activities**	**Instruments**
Observation in class Formative assessment	Giving feedback	Check list

Plans and programs of the center

Complementary activities
Talks of experts (children's relatives...)

Lesson plan: Geometry Workshop (Maths)

Education Stage	Primary education	Year	6th grade
Subject		Maths	
Interdisciplinary relationship between areas		It is connected with Art and Technology.	
Learning Situacion		**Title: Geometry workshop**	
Education Goals		**1. Deepen conceptual understanding** of fundamental Geometric elements such as shapes, lines, angles, and spatial relationships, using both two-dimensional and three-dimensional representations. **2. To develop spatial reasoning** by encouraging students to manipulate Geometric objects, visualize transformations, and explore symmetry and congruence in a tangible and interactive way. **3. To promote mathematical thinking** through inquiry-based learning and problem-solving activities where students must apply logic, strategy, and precision in real-life or creative contexts. **4. To encourage creativity and design** as students construct their own Geometric models or artistic compositions, integrating Mathematics with visual expression. **5. To incorporate digital tools and innovation** by using technologies such as interactive apps or holographic displays to support understanding and engagement with complex concepts. **6. Foster collaborative learning** through group tasks that require communication, teamwork, and shared responsibility, helping students learn from each other. **7. To build confidence and motivation** by creating a positive and dynamic learning environment where experimentation, discovery, and student-led exploration are encouraged.	
SDG relationship		Quality Education (SDG 4) Gender equiality (SDG 5) Industry, Innovation, and Infrastructure (SDG 9) Partnerships for the Goals (SDG – 17)	
Methodolgy			

Students will solve real-life Geometry problems by experimenting, questioning, and testing ideas through hands-on activities. Each group will design and build a Geometric model or artwork that applies concepts like symmetry, angles, and spatial reasoning. Students will integrate Math with Art by creating original Geometric designs that demonstrate understanding of key concepts.
Grouping
Students will be organized into heterogeneous small groups of 3–4 members to encourage peer support, collaboration, and shared problem-solving.
Didactic sequencing

Resources	Task description
- Printed geometric shapes - Rulers and protractors - Tablets or laptops - Hologram viewer / app https://polypad.amplify.com/p	**Lesson 5: Geometry workshop** Students work in collaborative groups using Mathigon Polypad to explore and construct 2D Geometric figures. They manipulate polygons to investigate symmetry, congruence, angles, and spatial relationships. Each group designs an original Geometric art composition, integrating visual creativity with mathematical precision. Through inquiry-based tasks, students apply logical reasoning to solve spatial challenges and present their models, fostering discussion, collaboration, and reflection.

Atention to the diversity
Students will choose from leveled challenges (basic shapes → complex designs) based on their readiness. Holograms, tactile models, and digital apps (Mathigon) accommodate visual, kinesthetic, and auditory learners. Mixed-ability groups ensure peer support; advanced learners mentor others.
Assessment

Technics	Activities	Instruments
Observation	- Students collaborate in groups using Mathigon Polypad to explore transformations. - Hands-on manipulation of geometric shapes.	- Observation checklist (e.g. "Active participation," "Accurate terminology use"). - Video recordings for later analysis.
	- Automated Mathigon reports on activity and errors. - Interactive quizzes (Kahoot/Quizizz).	- Platform analytics (progress graphs, common mistakes).
Digital Tracking	- Students evaluate peer projects using rubrics (e.g., creativity, precision). - Group discussions on problem-solving strategies.	- Peer feedback forms (Google Forms). - Simplified rubric for student use.
	- Physical model building	

Peer Feedback **Hands-on Artifacts** **Reflective Journals**	(paper, glue, etc.). - Digital 3D models (Tinkercad). - Students document how they applied geometry in designs. - Self-analysis of challenges/successes.	- Portfolio samples. - Scoring criteria (structure, concept application). - Guided templates (e.g. "What did I learn?"). - Critical thinking rubrics.

Plans and programs of the center
The center will integrate the Geometry Workshop into weekly STEAM labs and monthly "Math in Nature" field trips, using tools like Mathigon and 3D modeling apps. These programs align with SDG 4 (Quality Education) and foster hands-on, collaborative learning.

Complementary activities
Students create Geometric art projects and display them in a school gallery, combining math and creativity. Weekly sessions feature Geometry puzzles and team competitions to reinforce problem-solving skills. Visits to local landmarks let students analyze real-world geometric structures and their applications.

Curricular elements

Programming Unit			Timing	40 minutes	Sessions	1
Education Stage	PRIMARY	Year	6th GRADE			
Subject		PHYSICS HUMAN AND NATURE				
Interdisciplinary relationship between areas		Biology Physics				
Learning Situacion		Global warming				
Education Goals		To meet the concept "global warming", what provoke global warming, what does it cause and measures to prevent it.				
SDG relationship		Aim 13: Fighting against climate changes Aim 4: Quality education Aim 3: Good health and well-being				

Basic Knowledge

- To connect air pollutants with the formation of greenhouse effect.
- To participate in making posters for the negative outcome by human activity for the pollution of the environment.
- To comment the people's responsibility to keep and save the environment.
- Safety and efficient work with ICT.

Methodolgy

Observation, Demonstration, Discussion, Active participation, Usage of ICT

Grouping

Individual work and working in small groups, team work.

Didactic sequencing

Resources	Task description

Laptop Hologram hardware Screen Websites Posters Didactic materials	SESSION 1 - To do a puzzle on the topic „Why the planet is sad?". - Usage of the hologram hardware to present the greenhouse effect. - Discussion about the causer of the greenhouse effect and the consequences from it. - Air climate changes and children's health – discussion and making posters, how to help keeping the environment from the global warming.

Atention to the diversity

Books – encyclopedia on the topic for fast-learning students.

Help for the students with difficulties by the fast-learning students.

Assessment

Technics	**Activities**	**Instruments**
Observation in class – students' activity Formative evaluation	Providing feedback Self-evaluation of the students	Control sheet

Plans and programs of the centre

Complementary activities

Discussion with a lecturer

Curricular elements
Basic Knowledge

Programming Unit			**Timing**	80-90 minutes	**Sessions**	2
Education Stage	PRIMARY	**Year**	5^{th} – 7^{th} GRADE			
Subject			**PHYSICS HUMAN AND NATURE**			
Interdisciplinary relationship between areas			Mathematics Geography			
Learning Situacion			**Temperature and thermometers**			
Education Goals			To become familiar with the concept of "temperature" and its unit of measurement: degree "Celsius". To become familiar with the structure of different types of thermometers and the method of reading the temperature from them.			
SDG relationship			Goal 13: Combating Climate Change Goal 4: Quality Education			

- To be able to determine temperature as a measure of how hot or cold the body is.
- To know that degree Celsius is a unit of temperature and to be able to use its abbreviation "°C".
- To recognize the melting point of ice and the boiling point of water. To compare temperatures below 0 °C.
- To list and name the parts of different types of thermometers and know their purpose. To know about the existence of electronic thermometers.
- Safe and effective use of ICT.

Methodolgy
Observation, Demonstration, Discussion, Active participation, Use of ICT

Grouping
Individual work and working in pairs or small teams.

Didactic sequencing	
Resources	**Task description**
Laptop Holographic hardware Screen Websites Worksheets Didactic materials Thermometers /mercury, alcohol, electronic/	SESSION 1 - Interesting facts about different geographical areas with the highest and lowest temperatures on planet Earth; - Creating a chart from conducted observations of air temperatures in different populated areas; - Temperature and movement of building particles /same molecules of cold and hot water, but different speed: higher speed in hot water/. - Measuring the temperature in a cup of warm water and a cup with ice at intervals and recording the results in a table – group work/experiments; SESSION 2 - Using holographic hardware to present the structure of a thermometer – reservoir; mercury or alcohol; scale – marks, divisions, and numbers; glass tube, and for electronic thermometers – electronic display; - Measuring human body temperature with: a medical thermometer and a digital medical thermometer – work in pairs. - Climate changes and children's health – discussion and creation of posters on how to help protect the environment from global warming.

Atention to the diversity
Books – encyclopedias on the topic for fast learners. Help for students with difficulties provided by fast learners.

Assessment		
Technics	**Activities**	**Instruments**

Observation in class – student activity Formative assessment	Providing feedback Self-assessment of students (using emoticons)	Control sheet
Plans and programs of the centre		
Complementary activities		
A discusión with the school nurse about the risks associated with high human body temperature and practical advice on how to cope with such situations.		

Lesson plan: Let's make a presentation about Geometry (Maths)

Methodolgy

Programming Unit		**Timing**		**Sessions**	6
Education Stage	Primary education	**Year**	6th grade		
Subject		Maths			
Interdisciplinary relationship between areas		It is connected with **ICT (digital tools), Art (visual design), and Language (presentation skills).**			
Learning Situation		**Title:** Let's make a presentation about Geometry			
Education Goals		1. **Research skills**: Students investigate geometric concepts (shapes, angles, symmetry), using digital and printable resources. 2. **Digital literacy**: To create engaging presentations using tools like PowerPoint, Google Slides, or Canva, integrating text, images, and animations. 3. **Collaboration**: To work in teams to divide tasks between them (research, design, speaking) and peer-review presentations. 4. **Mathematical communication**: To explain geometric concepts clearly using appropriate terminology and real-world examples. 5. **Creativity**: To design visually appealing slides with original diagrams or digital models (e.g. made with Mathigon or GeoGebra).			
SDG relationship		Quality Education (SDG 4) Industry, Innovation, and Infrastructure (SDG 9)			

Students will work in groups and teams to research, design, and present geometric topics using digital tools like GeoGebra and PowerPoint, with peer assessment at the end.
Grouping
Students will work in mixed-ability teams of 3-4, ensuring balanced participation. Each group will include roles like researcher, designer, and presenter to develop collaboration skills while creating their Geometry presentations.
Didactic sequencing

Resources	**Task description**
- Laptops, tablets with internet access - Presentation software (PowerPoint / Google Slides) - Math apps (GeoGebra, Mathigon) - Rubrics and checklist printouts - Sample presentation templates	**Lesson 6: Let's make a presentation about Geometry** Students research geometric concepts in groups using digital tools and create presentation slides with visuals. Groups design interactive elements (e.g. GeoGebra models) and practice clear explanations of their topics. Final presentations include peer feedback using rubrics focused on content accuracy and engagement.

Attention to the diversity
Assign group tasks (researcher, designer, presenter) based on students' strengths – visual, verbal, or kinesthetic learners. Provide templates (for structure) and optional challenge extensions (e.g. "Include a 3D model") to accommodate varying skill levels. Offer bilingual glossaries or sentence stems for EAL students to explain Geometric concepts clearly.
Assessment

Technics	Activities	Instruments
Peer Feedback	Students assess presentations using simplified rubrics with icons / colors.	Visual rubric (emoji-scale) + audio recordings for non-writers.
Teacher Observation	Monitors group dynamics with focus on equitable participation.	Checklist tracking individual contributions (✅/💥 system).
Digital Portfolios	Students upload work samples (slides, GeoGebra models) with voice notes.	Platform like Seesaw with multimodal options (text / audio / video).

Plans and programs of the center
The center will integrate this Geometry unit into its annual **STEM Fair**, where students present projects to families and local experts. A **"Math Mentorship" program** pairs older students with 6th grade learners to refine presentations and build confidence.

Complementary activities
"Geometric design" – Decorating school notebooks with Geometric patterns. "Shape and taste" – Baking cookies in Geometric shapes during home economics classes.

Programming Unit			Timing	80-90 minutes	Sessions	2
Education Stage	PRIMARY	Year	5th – 7th GRADE			

Lesson plan: Temperature and therometers (Physics, Human and Nature)

Subject	**PHYSICS HUMAN AND NATURE**
Interdisciplinary relationship between areas	Mathematics Geography
Learning Situacion	**Temperature and thermometers**
Education Goals	To become familiar with the concept of "temperatura" and its unit of measurement: degree "Celsius". To become familiar with the structure of different types of thermometers and the method of reading the temperature from them.
SDG relationship	Goal 13: Combating Climate change Goal 4: Quality education

Curricular elements

Basic Knowledge

- Be able to determine temperature as a measure of how hot or cold a body is.
- Know that degree Celsius is a unit of temperature and be able to use its abbreviation °C.
- Recognize the melting point of ice and the boiling point of water. Compare temperatures below 0 °C.
- List and name the parts of different types of thermometers and know their purpose. Know about the existence of electronic thermometers.
- Safe and effective use of ICT.

Methodolgy

Observation, Demonstration, Discussion, Active participation, Usage of ICT

Grouping

Individual work and working in pairs or small teams.

Didactic sequencing

Resources	**Task description**
Laptop Holographic hardware Screen Websites Worksheets Didactic materials	SESSION 1 - Interesting facts about different geographical areas with the highest and lowest temperatures on planet Earth; - Creating a chart from conducted observations of air temperatures in

Thermometers /mercury, alcohol, electronic/	different populated areas; - Temperature and movement of building particles /same molecules of cold and hot water, but different speed: higher speed in hot water/. - Measuring the temperature in a cup of warm water and a cup with ice at intervals and recording the results in a table – group work/experiments; SESSION 2 - Using holographic hardware to present the structure of a thermometer – reservoir; mercury or alcohol; scale – marks, divisions, and numbers; glass tube, and for electronic thermometers – electronic display; - Measuring human body temperature with: a medical thermometer and a digital medical thermometer – work in pairs. - Climate changes and children's health – discussion and creation of posters on how to help protect the environment from global warming.

Atention to the diversity

Books - encyclopedias on the topic for fast learners.
Help for students with difficulties provided by fast learners.

Assessment

Technics	**Activities**	**Instruments**
Observation in class – student activity Formative assessment	Providing feedback Self-assessment of students (using emoticons)	Control sheet

Plans and programs of the center

Complementary activities

A discussion by the school nurse about the risks associated with high human body temperature and practical advice on how to cope with such situations.

Lesson plan: Properties of Water (Physics, Human and Nature)

Curricular elements
Basic Knowledge

Programming Unit			Timing	80-90 minutes	Sessions	2
Education Stage	PRIMARY	**Year**	5th – 7th GRADE			
Subject			**PHYSICS HUMAN AND NATURE**			
Interdisciplinary relationship between areas			Chemistry, Fine Arts, Technology and Entrepreneurship, Biology			
Learning Situacion			**Properties of Water**			
Education Goals			To systematize and enrich their knowledge about the states and properties of water. To improve their skills in transferring knowledge to familiar situations by specifying the algorithm for studying a substance using the example of water. To get acquainted with the concept of "solution".			
SDG relationship			Goal 6: Clean Water and Sanitation Goal 14: Life Below Water Goal 4: Quality Education			

- To describe the state of water.
- To be able to characterize water as a substance with specific properties (color, smell, etc.).
- To describe aqueous solutions as homogeneous mixtures.
- To give examples of changes in water when the temperature changes.
- To describe the temperature anomalies of water and their significance.
- Safe and efficient use of ICT.

Methodology
Discussion, Demonstration, Active participation, Usage of ICT
Grouping
Individual work and work in small groups/teams
Didactic sequencing

Resources	Task description
MozaBook - screen/smartboard	SESSION 1

Laptop Projector Holographic hardware Websites Worksheets Didactic materials Mind maps Lapbook	- Presentation about the three states of water in nature /solid – icebergs; liquid – oceans, seas, etc.; gaseous – water vapor in the air /; - Demonstration / experiments/ on the states of water /ice, water and steam/; - Determining the properties of water / tasteless, odorless, transparent, boiling point 100° C/ - by experiments; - Water as a good solvent – experiments with salt, sugar, alcohol, etc.; - Mind map /drawing "The Water Cycle in Nature". SESSION 2 - Using holographic hardware to present the properties of water; - Group work /teams: through experiments filling in a graph about the anomalous thermal expansion of water /water when heated from 0° C to 4° C instead of expanding, as is the case with other liquids, it contracts, i.e. it occupies a smaller volume and is the heaviest/; - Using holographic hardware to present information about the significance of temperature anomalies /how animals and plants survive in water in winter/; - Creating a Lapbook project "Water" finding information using ICT.

Atention to the diversity

Leaflets and brochures with interesting facts for quick learners.
Providing support and help from quick learners to students who are struggling.

Assessment

Technics	**Activities**	**Instruments**
Classroom observation – student activity Formative assessment	Providing feedback Student self-assessment (using emoticons or gestures)	Checklist

Plans and programs of the center

Complementary activities

A lecture by an expert – ecologist (students' relatives) on the topic: 'Protecting Water and Water Resources in Our Local Area'.

Lesson plan: Plan for the future (Natural Science)

<table>
<tr><td>Programming Unit</td><td>Timing</td><td>2nd Term</td><td>Sessions</td><td>3 Sessions</td></tr>
<tr><td colspan="2">Education Stage Year</td><td colspan="3">6 Year Primary Eduaction (11-12 years old kids)</td></tr>
<tr><td colspan="2">Subject</td><td colspan="3">Natural Science</td></tr>
<tr><td colspan="2">Interdisciplinary relationship between areas</td><td colspan="3">What common element are worked on coinciding with those of other subjects?
English, Maths & Social Science
Implicit Soft Skills: Critical Thinking, Communicative Skills, Problems Solving, Creativity.</td></tr>
<tr><td colspan="5">We Take Care of the Earth</td></tr>
<tr><td colspan="2">Learning Situacion</td><td colspan="3">
</td></tr>
<tr><td colspan="2">Education Goals</td><td colspan="3">1. To research the causes and consequences of Climate Changes & Global Warming focusing on ecosystems and human communities.
2. To purpose sustainable solutions to mitigate the impact and effects of the Climate Change at local level.
3. To interact with some AI experts about the topic in order to get real conclusions and consolidate the knowledge.</td></tr>
<tr><td colspan="2">SDG relationship</td><td colspan="3">The 2030 Agenda for Sustainable Development, adopted by all United Nations Member States in 2015, provides a shared blueprint for peace and prosperity for people and the planet, now and into the future. At its heart are the 17 Sustainable Development Goals (SDGs), which are an urgent call for action by all countries - developed and developing - in a global partnership.
11 – Sustainable cities and communities
12 – Responsible consumption and production
13 – Climate action</td></tr>
<tr><td colspan="5">Basic Knowledge</td></tr>
</table>

- To understand that the Earth is getting warmer because of gases like carbon dioxide.
- To know that burning fuels in cars, factories and homes release harmful gases that make the Earth hotter.
- To recognize Global Warming affects nature by causing natural disasters.
- To develop and acquire skills and behaviours to contribute to sustainable consuming habits.

Methodology & Grouping
Project-based learning, cooperative / collaborative learning, experiential learning, AI learning. Small group work (researching), individual work (interaction and reflection with the AI), whole class (discussing about the topic)

Didactic Sequencing

Resources	**Task description**

<table>
<tr>
<td>Books
Digital
ChatGP
T

Microsoft
Work
Videos</td>
<td>

Lesson 1: Introduction to Global Warming:

1. Watch a short video explaining Global Warming in simple terms.

2. Brainstorming and debate about the topic related to our community.
3. Writing and drawing: Expose your ideas in the notebook.

Lesson 2: Global Warming effects and solutions:

1. Group activity: Match climate vocabulary with corresponding pictures. (Wordwall - Tablet)
2. Go to the National Geographic Kids link and complete a test about Global Warming.
3. Go to the ODS website and search which goals and directly related to the topic.
4. Share ideas with the class.

Lesson 3: AI could help us:

1. Design a prompt (with some questions) using teacher example to create a learning context where AI plays the role of a climatologist expert.

2. Ask the AI and take notes of the most significant aspects.
3. To compare and discuss the AI answers in order to check if the feedback is correct.

</td>
</tr>
</table>

Lesson 4: Test, Conclusions & Discussion:

1. Plickers

2. Check the answers, presentation and discussion.

Attention to the diversity
We contemplate some Attention to Diversity measures depending on the cases.

Assessment		
Technics	**Activities**	**Learning Standards**
Check list Peer-Assessment Self-Assessment Direct Observation Oral Exposition	Activities designed to evaluate. Interactive test Group Work rating scale	Explain specific concept about Global Warming. Analyse the environmental, social, economical & natural impact of Global Warming. Develop and implement strategies to reduce the carbon footprint. Reflect and discuss the use of AI as a resource AI.

DANK U DAT U ONS ONTVANGEN HEBT. DANKE, DASS SIE UNS EMPFANGEN HABEN. DZIĘKUJEMY ZA GOŚCINĘ.

GRAZIE PER AVERCI OSPITATO. GRÀCIES PER HAVER-NOS ACOLLIT. GRACIES POR ACOYER-NOS. THANK YOU FOR HAVING US

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