



Empowering High School Girls in STEM: A Toolkit for Success

This toolkit is designed to provide guidance and support to high school girls who are considering pursuing a career in STEM (Science, Technology, Engineering, and Mathematics).

It aims to inspire, motivate, and equip these young women with essential resources and information necessary to embark on a successful STEM journey.

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SECTION 1: Understanding the importance of STEM



01

What is STEM?

02

An overview of the significance of STEM fields in today's world.

03

An overview of the different STEM disciplines



I.I. What is STEM?



Our world is constantly changing. Almost 70% of primary school students will live in a different world and will choose jobs that don't even exist at the moment. But we can be sure about one thing: STEM skills will play a major role in the careers of the future.

- **STEM** is an acronym that stands for **Science, Technology, Engineering,** and **Mathematics**. It refers to an interdisciplinary approach to learning and problem-solving that integrates these four subjects.
- **STEM** education focuses on developing critical thinking, creativity, problem-solving skills, and collaboration in students. It encourages students to apply their knowledge and skills in real-life contexts and prepares them for future careers in fields such as engineering, computer science, medicine, and research.
- **STEM** education aims to foster a deeper understanding of these subjects and promote innovation and technological advancement in various industries.



1.2. An overview of the significance of STEM fields in today's world.



STEM fields are of utmost significance in today's world.

They drive economic growth, technological advancements, and innovation, while also addressing global challenges.



STEM fields play a crucial role in today's world, shaping various aspects of society and driving innovation. Here is an overview of their significance:



Economic Growth: STEM fields are essential for economic growth and development. They drive technological advancements, create high-paying jobs, and foster innovation in industries such as manufacturing, healthcare, finance, and information technology. A robust STEM workforce is crucial for a country's competitiveness in the global economy.

Technological Advancements: STEM fields are at the forefront of technological advancements that shape our daily lives. From smartphones to artificial intelligence, renewable energy to space exploration, STEM professionals drive innovation and revolutionize industries, making our lives more convenient, efficient, and sustainable.

Problem-solving and Critical Thinking: STEM education cultivates problem-solving skills and encourages critical thinking. Students in STEM fields learn to analyze complex problems, break them down into smaller components, and develop creative solutions. These skills are valuable not only in STEM-related careers but also in various other fields, promoting a well-rounded workforce.



Global Challenges: STEM fields are crucial in addressing global challenges such as climate change, disease outbreaks, food scarcity, and cybersecurity. Scientists, engineers, and mathematicians work together to find sustainable solutions, develop new technologies, and advance research to tackle these pressing issues and ensure a better future for humanity.

Career Opportunities: STEM fields offer a wide range of rewarding and high-demand career opportunities. The demand for STEM professionals continues to grow as industries increasingly rely on technology and data-driven decision-making. Careers in STEM often provide competitive salaries, job security, and opportunities for personal and professional growth.

Diversity and Inclusion: Encouraging diversity and inclusion in STEM fields is crucial for fostering innovation and addressing societal challenges effectively. By promoting diversity, we can tap into a wide range of perspectives, experiences, and ideas, leading to more inclusive and equitable solutions.

Education and Workforce Development: Emphasizing STEM education is vital to develop a skilled and capable workforce. By providing quality STEM education from an early age, we can inspire and prepare students for future careers in these fields. Investing in STEM education ensures a pipeline of talent and helps bridge the skills gap in the job market.

Scientific Literacy: STEM education promotes scientific literacy among individuals, enabling them to make informed decisions and critically evaluate information. In an era of misinformation and fake news, understanding scientific concepts and principles empowers individuals to distinguish fact from fiction, contributing to a more informed and engaged society.



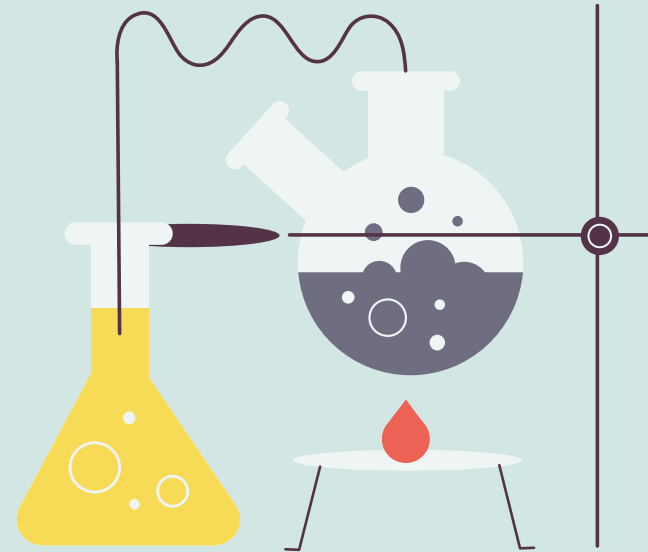
2.1. An overview of the different STEM disciplines

- **Science**
- **Technology**
- **Engineering**
- **Mathematics**
- **Architecture**

STEM disciplines are closely intertwined, with each contributing to the others.

For example, science provides the foundation for technology and engineering, while mathematics is essential for scientific analysis and engineering design.

Together, these disciplines drive innovation, advancements, and progress in various industries and help solve complex challenges facing our society.



Science is the systematic study of the natural world and the processes that occur within it. It involves observing, questioning, and experimenting to understand how things work. Science is further divided into various branches such as physics, chemistry, biology, and earth sciences. Physics deals with matter, energy, and the fundamental forces of nature. Chemistry focuses on the composition, properties, and reactions of substances. Biology explores living organisms and their interactions. Earth sciences study the planet Earth, including its geology, weather, and ecosystems.



Technology refers to the application of scientific knowledge to create tools, machines, systems, and processes that improve our lives. It involves designing, developing, and using various technological innovations. Technology can be found in everyday objects, such as smartphones, computers, transportation systems, medical devices, and renewable energy sources. It also includes fields like computer science, information technology, and telecommunications.



Engineering is the application of scientific and mathematical principles to design, develop, and improve structures, systems, and processes. Engineers use their knowledge to solve real-world problems and create innovative solutions. There are various branches of engineering, including civil engineering (designing infrastructure and buildings), mechanical engineering (designing machines and mechanical systems), electrical engineering (working with electrical circuits and power), chemical engineering (dealing with chemical processes), and many more.



Mathematics is the study of numbers, patterns, shapes, and relationships. It provides a language and tools for understanding and solving problems. Mathematics is divided into several branches such as algebra, geometry, calculus, statistics, and probability. It is fundamental to many fields, including physics, engineering, computer science, economics, and finance. Mathematics helps in analyzing data, making predictions, and developing logical reasoning skills.



Architecture integrates design and technology, science, engineering and mathematics, making it a perfect example of a STEM career. In 2018, the United States formally identified architecture as a STEM subject. Meanwhile, in many parts of the world, architecture is still more linked with design and arts.



SECTION 2: EXPLORING STEM FIELDS



01

Exploring Exciting
Opportunities in
STEM



02

Potential career
paths within each
STEM field



03

Impact of STEM in
various industries,
such as healthcare,
environmental
conservation, and
technology.



2.1. Exploring Exciting Opportunities

The field of Science, Technology, Engineering, and Mathematics (STEM) offers an array of diverse and rewarding opportunities for students.



Research Scientist

Software Engineer

Biomedical Engineer

Environmental Scientist



Data Scientist

Aerospace Engineer

Civil Engineer

Robotics Engineer

2.1. Exploring Exciting Opportunities

The field of Science, Technology, Engineering, and Mathematics (STEM) offers an array of diverse and rewarding opportunities for students.



Research Scientist



Software Engineer

Biomedical Engineer

Environmental Scientist

For those with a passion for discovery and a curiosity to unravel the mysteries of the world, a career as a research scientist might be the perfect fit. Research scientists work in various fields, such as biology, chemistry, physics, and environmental science, conducting experiments, analyzing data, and contributing to scientific advancements.

2.1. Exploring Exciting Opportunities

The field of Science, Technology, Engineering, and Mathematics (STEM) offers an array of diverse and rewarding opportunities for students.



Research Scientist

Software Engineer



Biomedical Engineer

Environmental Scientist

In the digital age, software engineering plays a crucial role in every aspect of our lives. Software engineers design, develop, and maintain software systems. They work on cutting-edge technologies, develop mobile apps, create video games, and contribute to artificial intelligence and machine learning.

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Research Scientist

Software Engineer

Biomedical Engineer



Environmental Scientist

Combining principles of engineering and medical sciences, biomedical engineers work towards improving healthcare and medical technologies. They design and develop prosthetics, artificial organs, medical equipment, and imaging systems. They also collaborate with healthcare professionals to create innovative solutions for patient care.

2.1. Exploring Exciting Opportunities

The field of Science, Technology, Engineering, and Mathematics (STEM) offers an array of diverse and rewarding opportunities for students.



Research Scientist

Software Engineer

Biomedical Engineer

Environmental Scientist



With a growing focus on sustainability and conservation, environmental scientists play a vital role in protecting our planet. They study the environment, analyze data, and develop strategies to mitigate climate change, manage natural resources, and preserve ecosystems. Environmental scientists can work in government agencies, non-profit organizations, or private companies.

2.1. Exploring Exciting Opportunities

The field of Science, Technology, Engineering, and Mathematics (STEM) offers an array of diverse and rewarding opportunities for students.

In the era of big data, data scientists are in high demand. They analyze large sets of complex data to extract meaningful insights, predict trends, and aid decision-making. Data scientists work in diverse industries, such as finance, healthcare, marketing, and e-commerce, and utilize programming skills, statistics, and machine learning techniques.

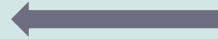


Data Scientist

Aerospace Engineer

Civil Engineer

Robotics Engineer



2.1. Exploring Exciting Opportunities

The field of Science, Technology, Engineering, and Mathematics (STEM) offers an array of diverse and rewarding opportunities for students.

For those fascinated by space exploration and aircraft technology, a career as an aerospace engineer can be thrilling. Aerospace engineers design and develop aircraft, spacecraft, satellites, and rockets. They work on propulsion systems, aerodynamics, materials, and navigation systems, pushing the boundaries of human exploration.



Data Scientist

Aerospace Engineer

Civil Engineer

Robotics Engineer



2.1. Exploring Exciting Opportunities

The field of Science, Technology, Engineering, and Mathematics (STEM) offers an array of diverse and rewarding opportunities for students.

Civil engineers are the architects of our infrastructure. They design and oversee the construction of bridges, roads, buildings, dams, and water supply systems. Civil engineers play a crucial role in ensuring public safety, sustainable development, and efficient transportation networks.

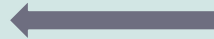


Data Scientist

Aerospace Engineer

Civil Engineer

Robotics Engineer



2.1. Exploring Exciting Opportunities

The field of Science, Technology, Engineering, and Mathematics (STEM) offers an array of diverse and rewarding opportunities for students.

As robots become increasingly integrated into our lives, robotics engineers are at the forefront of this technological revolution. They design, develop, and program robots for various applications, including manufacturing, healthcare, and space exploration. Robotics engineers combine mechanical engineering, electronics, and computer programming skills.



Data Scientist

Aerospace Engineer

Civil Engineer

Robotics Engineer



2.2. Potential career paths within each STEM field

Science

- Physicist
Conduct research on the properties and behavior of matter and energy.
- Chemist
Study the composition, structure, and properties of substances.
- Biologist
Investigate living organisms, their functions, and interactions.
- Environmental Scientist
Analyze and address environmental issues and conservation efforts.
- Astronomer
Explore celestial bodies and phenomena in the universe.

Technology

- Software Developer
Design and develop computer programs and applications.
- Network Administrator
Manage and maintain computer networks within an organization.
- Cybersecurity Analyst
Protect computer systems from unauthorized access and cyber threats.
- UX/UI Designer
Create user-friendly and visually appealing interfaces for websites and applications.
- Data Scientist
Analyze large datasets to extract meaningful insights and patterns.


2.2. Potential career paths within each STEM field

Mathematics

- Actuary
Assess and manage risks in insurance, finance, and investment industries
- Data Analyst
Analyze data to draw conclusions and support decision-making
- Operations Research Analyst
Use mathematical and statistical methods to optimize processes and solve complex problems
- Mathematician
Conduct research and develop mathematical theories and models.
- Financial Analyst
Analyze financial data and provide insights for investment decisions

Engineering

- Civil Engineer
Design and oversee construction projects like buildings, bridges, and infrastructure
- Mechanical Engineer
Develop and improve mechanical systems and devices
- Electrical Engineer
Design and maintain electrical circuits and power systems
- Aerospace Engineer
Design and develop aircraft, spacecraft, and related technologies
- Environmental Engineer
Work on solutions to environmental challenges, such as pollution control and sustainable development



2.3. Impact of STEM in various industries, such as healthcare, environmental conservation, and technology.



STEM has a significant impact on various industries, driving innovation, advancements, and solutions to complex challenges. Here are some examples of how STEM influences different sectors:





Environmental Conservation!

Renewable Energy Engineer
Conservation Scientist
Environmental Engineer



Healthcare!

Medical Technologist
Biotechnologist
Data Analyst in Healthcare

Technology!

Information Technology (IT) Specialist
Artificial Intelligence (AI) Engineer
Internet of Things (IoT) Developer

Aerospace and Transportation!

Aerospace Engineer
Autonomous Vehicle Engineer
Infrastructure Engineer





Environmental Conservation!

Renewable Energy
Engineer


STEM plays a vital role in the development of renewable energy sources such as solar, wind, and hydroelectric power, reducing dependence on fossil fuels and mitigating climate change

Conservation Scientist

STEM disciplines contribute to studying ecosystems, biodiversity, and climate patterns, helping to protect and restore natural habitats and conserve endangered species

Environmental Engineer

STEM professionals design and implement sustainable solutions for water and air pollution control, waste management, and sustainable infrastructure development





Healthcare!

Medical Technologist

STEM advancements have led to the development of advanced medical devices, imaging technologies, and diagnostic tools, improving patient care and treatment outcomes

Biotechnologist

STEM research has resulted in breakthroughs in genetic engineering, personalized medicine, and the development of new therapies for various diseases

Data Analyst in Healthcare

STEM professionals analyze large healthcare datasets to identify patterns, predict disease outbreaks, and improve healthcare delivery systems





Technology!

Information Technology
(IT) Specialist

STEM professionals drive innovation in software development, network security, and data management, enabling businesses to operate efficiently and securely

Artificial Intelligence (AI)
Engineer

STEM advancements in machine learning and AI algorithms have revolutionized industries, from autonomous vehicles and robotics to natural language processing and personalized recommendations

Internet of Things (IoT)
Developer

STEM expertise is essential in developing interconnected devices and systems that enhance automation, productivity, and efficiency in various sectors like manufacturing, agriculture, and smart cities





Aerospace and Transportation!

Aerospace Engineer

STEM professionals design and develop aircraft, spacecraft, and satellites, advancing space exploration and satellite communication systems

Autonomous Vehicle Engineer

STEM innovations in robotics, computer vision, and artificial intelligence have paved the way for self-driving cars, drones, and automated transportation systems

Infrastructure Engineer

STEM plays a crucial role in designing and constructing safe and efficient transportation systems, including bridges, highways, and railways





Empowering High School
Girls in STEM

CAREER
QUIZ



SECTION 3: WOMEN IN STEM



3.1

ROLE MODELS

Inspiring Women in STEM:
Real-Life Success Stories



3.2

Open educational
resources about
women in STEM



3.1. ROLE MODELS

Inspiring Women in STEM: Real-Life Success Stories

Marie Curie

Pioneer in Radioactivity
Research

Mae Jemison

First African-American
Woman in Space

Ada Lovelace

Pioneer of Computer
Programming

Hedy Lamarr

Inventor of Frequency
Hopping

Katherine Johnson

Mathematical Genius at
NASA

Rosalind Franklin

Pioneer in DNA Structure

Grace Hopper

Computer Programming
Innovator

Sally Ride

First American Woman
in Space

Chien-Shiung Wu

Nuclear Physics
Trailblazer

Marie Curie

Marie Curie, a Polish-born physicist and chemist, was the first woman to win a Nobel Prize and the only person to receive Nobel Prizes in two different scientific fields. Her groundbreaking research on radioactivity paved the way for advancements in medical treatments and radiation therapy.

Despite facing numerous challenges, Curie's determination and passion for science made her an icon and an inspiration for women in STEM.



Mae Jemison

Mae Jemison, an American astronaut, engineer, and physician, shattered barriers by becoming the first African-American woman to travel to space. Her passion for space exploration led her to become a NASA astronaut, where she contributed to groundbreaking research on bone cell research and space travel's impact on the human body. Jemison's achievements prove that determination and resilience can overcome any obstacles, inspiring future generations to reach for the stars.



Ada Lovelace

Ada Lovelace, an English mathematician and writer, is often regarded as the world's first programmer. In the 19th century, Lovelace wrote the first algorithm to be processed by a machine, making her a visionary in computer science. Her contributions to the field laid the foundation for modern-day programming and artificial intelligence. Lovelace's extraordinary foresight and analytical thinking continue to inspire women in the world of coding and technology.



Hedy Lamarr

Inventor of Frequency Hopping: Hedy Lamarr, an Austrian-born actress and inventor, made significant contributions to wireless communication technology during World War II. Together with composer George Antheil, Lamarr developed a frequency-hopping system to prevent the interception of radio-controlled torpedoes. This invention laid the groundwork for modern-day technologies such as Wi-Fi, Bluetooth, and GPS. Lamarr's story showcases the intersection of creativity, innovation, and scientific brilliance.



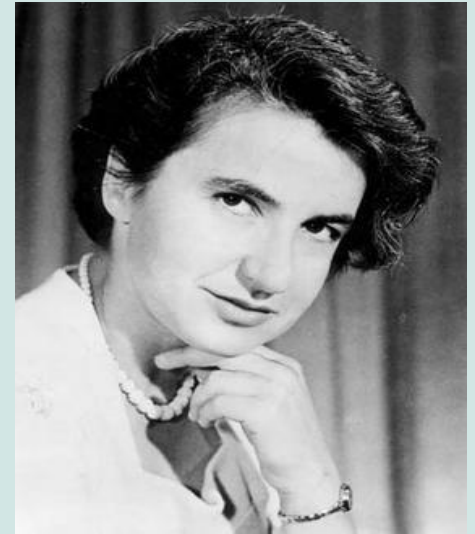
Katherine Johnson

Katherine Johnson, an African-American mathematician, played a pivotal role in NASA's space program during the 1960s. Her calculations were critical in the success of the first manned spaceflights, including the Apollo Moon landing mission. Despite facing racial and gender discrimination, Johnson's exceptional mathematical abilities and determination propelled her to heights few could imagine. Her story highlights the importance of diversity and inclusion in STEM fields.



Rosalind Franklin

Rosalind Franklin, a British chemist and X-ray crystallographer, played a crucial role in uncovering the structure of DNA. Her work in capturing X-ray images of DNA fibers provided key insights that led to the discovery of the double helix structure. Unfortunately, her contributions were initially overlooked, but her work laid the foundation for our understanding of genetics and molecular biology.



Grace Hopper

Computer Programming Innovator: Grace Hopper, an American computer scientist and Navy Rear Admiral, revolutionized computer programming by developing the first compiler, a program that translates high-level programming languages into machine code.

Her work paved the way for modern programming languages and made computers more accessible to a wider audience. Hopper's dedication to innovation and her belief in the power of programming continue to inspire generations of programmers.



Sally Ride

Sally Ride, an American astronaut and physicist, made history as the first American woman to travel to space. She joined NASA in 1978 and flew on the space shuttle Challenger in 1983.

Ride's achievements opened doors for women in space exploration and inspired countless young girls to pursue careers in science and engineering.



Chien-Shiung Wu

Chien-Shiung Wu, a Chinese-American physicist, made significant contributions to the field of nuclear physics. Her experiments disproved the long-held theory of conservation of parity, which led to a better understanding of the weak nuclear force. Wu's research and leadership paved the way for advancements in nuclear physics and solidified her position as one of the most influential physicists of the 20th century.



3.2. Open educational resources about women in STEM



POSTERS OF WOMEN IN STEM

You can explore stories of Diversity in STEM through posters. Teachers can download one or all of the posters to share in their classroom (with text edit) and explore women's in STEM educational backgrounds, career paths, and significant contributions to their respective fields.

The [AAAS IF/THEN® Ambassadors Program](https://www.ifthenshecan.org/ambassadors/) is a key element of the IF/THEN® Initiative designed to further women in science, technology, engineering and math (STEM) by empowering current innovators and inspiring the next generation of pioneers.



<https://www.ifthenshecan.org/ambassadors/>

3.2. Open educational resources about women in STEM



POSTERS OF WOMEN IN STEM

By examining their struggles, triumphs, and perseverance, students will gain insight into the challenges faced by women in STEM and the immense impact they have made.



<https://womeninstem.ingeniumcanada.org/posters/>



<https://womeninstem.ingeniumcanada.org/wp-content/uploads/2020/03/Ingenium-Women-in-STEM-Poster-Education-Resource-unit-5-Complete.pdf>



3.2. Open educational resources about women in STEM



INTERVIEWS OF WOMEN IN STEM

- Engaging interviews with successful women in STEM will provide students with first-hand accounts of their experiences, motivations, and the importance of diversity in STEM.
- These interviews will cover a range of STEM disciplines, including computer science, biology, engineering, mathematics, and more, ensuring that students can explore a variety of potential career paths.

You can visit the **The European Platform of Women Scientists (EPWS)** web page for interviews made with remarkable Women Scientists. EPWS is an international non-profit organisation that represents the needs, concerns, interests, and aspirations of more than 12.000 women scientists in Europe and beyond.



<https://epws.org/woman-scientist-interview-of-the-month/>

3.2. Open educational resources about women in STEM



OERs

Here are some Open Educational Resources (OERs) that focus on inspiring women in STEM:

"Women in Science" by the National Institutes of Health (NIH) - This resource explores the contributions of women in various scientific fields and provides profiles of pioneering women scientists.

Access it here: <https://www.nih.gov/womeninscience/index.htm>

"Women in STEM" by the United Nations Educational, Scientific and Cultural Organization (UNESCO) - This webpage highlights the achievements and challenges faced by women in STEM fields globally. It also includes links to additional resources and initiatives promoting gender equality in STEM.

Find it here: <https://en.unesco.org/themes/women-science/women-stem>

3.2. Open educational resources about women in STEM



OERs

"Women in STEM: A Gender Gap to Innovation" by the European Institute for Gender Equality (EIGE) - This report provides an overview of the gender gap in STEM fields, analyzing the causes and consequences, as well as suggesting strategies for promoting gender equality in STEM.



Download <https://eige.europa.eu/publications/women-stem-gender-gap-innovation> here:

"Women in Science and Engineering" by OpenLearn - This free online course explores the lives and contributions of women in science and engineering throughout history. It covers topics such as the challenges faced by women in STEM fields and the importance of diversity in scientific research.



Access it here: <https://www.open.edu/openlearn/science-maths-technology/engineering-technology/women-science-and-engineering/content-section-0>

3.2. Open educational resources about women in STEM



OERs

There are also several Open Educational Resources (OERs) available that offer opportunities for girls to engage in HANDS-ON ACTIVITIES in STEM. Here are a few examples:

Girls Who Code: Girls Who Code is a non-profit organization that aims to close the gender gap in technology. They provide free resources and curriculum for coding clubs, summer immersion programs, and after-school programs for girls in grades 3-12. Their curriculum covers a wide range of topics including coding, robotics, and web development.

Website: <https://girlswhocode.com/>

Code.org: Code.org is a non-profit organization that provides free coding resources for students of all ages. They offer a variety of online coding courses, tutorials, and projects suitable for beginners to advanced learners. Code.org also organizes the annual Hour of Code event to introduce students to coding.

Website: <https://code.org/>

3.2. Open educational resources about women in STEM



OERs

NASA STEM Engagement: NASA provides a wide range of educational resources and opportunities for students interested in STEM. They offer workshops, internships, contests, and programs specifically designed to engage girls in STEM fields. The NASA STEM Engagement website includes lesson plans, interactive games, videos, and virtual tours related to space exploration and scientific discovery.



Website: <https://www.nasa.gov/stem>

FIRST Robotics: FIRST (For Inspiration and Recognition of Science and Technology) Robotics offers various programs for students, including FIRST LEGO League and FIRST Tech Challenge, which are designed to engage children and teenagers in robotics and engineering. These programs often have separate divisions or events specifically for girls, encouraging them to participate and excel in STEM fields.



Website: <https://www.firstinspires.org/>



3.2. Open educational resources about women in STEM



OERs

National Girls Collaborative Project: The National Girls Collaborative Project (NGCP) aims to bring together organizations that are committed to increasing the participation of girls in STEM. Their website provides a directory of programs and resources that offer hands-on activities in STEM for girls. This directory can help you find local workshops, science fairs, coding camps, and robotics clubs specifically tailored for girls.



Website: <https://ngcproject.org/>



ACTIVITIES FOR STUDENTS

In groups, conduct a research project and make a PPT of one of the most famous women in STEM representing your country.

EXAMPLE:

Spain: Dr. Maria Blasco, Director of the Spanish National Cancer Research center (CNIO) and President of the SOMMA Alliance.

- Video: <https://www.youtube.com/watch?v=DnpXKeHzFX8>
- Article: <https://quo.eldiario.es/ciencia/a40928/seleccion-espanola-de-la-ciencia-2014-maria-blasco/>
- Poster Presentation: <https://www.slideshare.net/annaszczepaniak503/maria-blasco-by-spanish-studentspdf>



LESSON PLAN Women in STEM Biography

SECTION 4: OVERCOMING STEREOTYPES



Stereotypes are generalized ideas about a certain category of people. Gender stereotypes are formed through family upbringing, the education system, mass media, established cultural traditions.



SECTION 4: OVERCOMING STEREOTYPES



01 What are gender stereotypes?

02 Breaking Gender Stereotypes

03 Empowering Female Students in STEM: Breaking Barriers and Pursuing Success



4.1. What are gender stereotypes?

Stereotypes are generalized ideas about a certain category of people. Gender stereotypes are formed through family upbringing, the education system, mass media, established cultural traditions.

Gender stereotypes are preconceived and widely held beliefs or assumptions about the behaviors, characteristics, roles, and attributes that are typically associated with individuals based on their perceived gender.



Some common gender stereotypes include:

- **Masculine stereotypes**

Men are expected to be strong, stoic, assertive, and dominant. They should avoid displaying emotions such as vulnerability or sensitivity, and they are often associated with careers in leadership, engineering, or physically demanding roles.

- **Feminine stereotypes**

Women are often expected to be nurturing, empathetic, submissive, and emotionally expressive. They are typically associated with caregiving roles, such as nursing or teaching, and may be encouraged to prioritize family and home life over career aspirations.

These stereotypes dictate what tasks or activities are considered suitable or appropriate for each gender. For example, the belief that women should primarily handle household chores while men should focus on outdoor or mechanical tasks.

Can limit individual potential and choices, leading to unequal opportunities and treatment based on gender. They can also contribute to gender discrimination and bias in areas such as education, employment, and personal relationships. It is important to challenge and break down these stereotypes to promote gender equality and create a more inclusive and diverse society. Recognizing that individuals can have a wide range of interests, abilities, and characteristics regardless of gender is crucial in combating gender stereotypes.

- **Stereotypical gender roles**

- **Gender stereotypes**

Gender stereotypes in SCIENCE

Gender stereotypes in science, particularly those related to women, have been prevalent for a long time and continue to persist in various forms. These stereotypes can discourage women from pursuing careers in science, technology, engineering, and mathematics (STEM) fields and can also create barriers for those who do enter these professions. Here are some common gender stereotypes of women in science:

Lack of Ability

One of the most damaging stereotypes is the belief that women are inherently less capable or skilled in scientific disciplines. This stereotype suggests that women are not as naturally inclined towards math or science and that their abilities in these fields are limited.

Emphasis on Appearance

Women in science may face judgments and biases related to their appearance rather than their qualifications or contributions. Stereotyping women based on their looks rather than their intellect undermines their expertise and contributions to the field.

Emotional Instability

Another stereotype suggests that women are more emotional and less rational than men, making them less suited for objective scientific inquiry. This stereotype overlooks the fact that emotions are a universal human trait and do not impact one's scientific abilities.

Gender stereotypes in SCIENCE

Lack of Ambition

Women are sometimes perceived as less ambitious in their scientific careers, which can lead to fewer opportunities and responsibilities being offered to them compared to their male counterparts.

Motherhood Penalty

Women in science may face discrimination and reduced opportunities after having children due to the assumption that motherhood will hinder their commitment to their scientific work.

Tokenism

Some women in science may experience being treated as tokens, leading to feelings of isolation and increased pressure to represent all women in their field.

Hostile Work Environment

Gender stereotypes can contribute to a hostile work environment in male-dominated scientific fields, where women may face harassment, microaggressions, or lack of support.

Underrepresentation

Stereotypes can perpetuate the underrepresentation of women in leadership roles and senior positions within scientific organizations and institutions.

**A WOMAN CANNOT BE A GOOD
SURGEON, LAWYER,
POLITICIAN**

FALSE!

A person's ability to excel in any profession is not determined by their gender but rather by their knowledge, skills, education, experience, and dedication to their profession.

**GIRLS ARE NOT GOOD AT
MATHS**

FALSE!

Girls, like boys, are not a homogenous group. Each person is unique and has their own set of strengths, weaknesses, and interests. Some girls may excel at mathematics, while others may not, just as it is with boys or any other gender.

**IF A WOMAN IS ECONOMICALLY
INDEPENDENT, THEN SHE IS
UNLIKELY TO HAVE A
SUCCESSFUL
PERSONAL LIFE**

FALSE!

This stereotype perpetuates the idea that women should prioritize family and relationships over their careers or financial independence.

WOMEN IN STEM STEREOTYPES



4.2. Breaking Gender Stereotypes

Breaking gender stereotypes is not a one-time effort but a continuous journey towards creating a more equitable and inclusive society. It requires collective action, empathy, and a commitment to celebrating the diversity of human identities and experiences. By challenging stereotypes, we can create a world where everyone is free to be their authentic selves, regardless of gender.



- ✓ **Education and Awareness:** Educate people about the harmful impact of gender stereotypes. Raise awareness about how these stereotypes limit opportunities, create biases, and perpetuate inequality.
- ✓ **Encourage Diverse Interests and Hobbies:** Encourage children and young individuals to explore a wide range of interests and hobbies regardless of traditional gender norms. Support their choices without imposing gender-based limitations.



- ✓ **Equal Opportunities:** Advocate for equal opportunities in education, employment, and leadership positions for people of all genders. Address any institutional biases that hinder access to such opportunities.
- ✓ **Challenging Media Representation:** Critically assess media representations of gender and challenge stereotypical portrayals. Promote media that showcases diverse and authentic gender roles.
- ✓ **Language and Communication:** Be mindful of the language we use and avoid reinforcing stereotypes through our words. Use inclusive language that acknowledges and respects individuals' identities.
- ✓ **Role Models:** Promote and celebrate diverse role models who have defied traditional gender norms and achieved success in their chosen fields.
- ✓ **Encourage Emotional Expression:** Break the stereotype that restricts emotions based on gender. Encourage everyone to express their feelings openly and without judgment.
- ✓ **Supportive Parenting:** Parents can play a crucial role in breaking gender stereotypes by supporting their children's interests and talents, irrespective of gender expectations.
- ✓ **Collaboration and Inclusion:** Encourage collaborative efforts that bring people of all genders together to work towards common goals. Emphasize the importance of inclusive and respectful teamwork.



BREAKING STEREOTYPES

**Education
and
Awareness**



**Encourage
Diverse
Interests and
Hobbies**



**Equal
Opportunities**



**Role
Models**



**Supportive
Parenting**



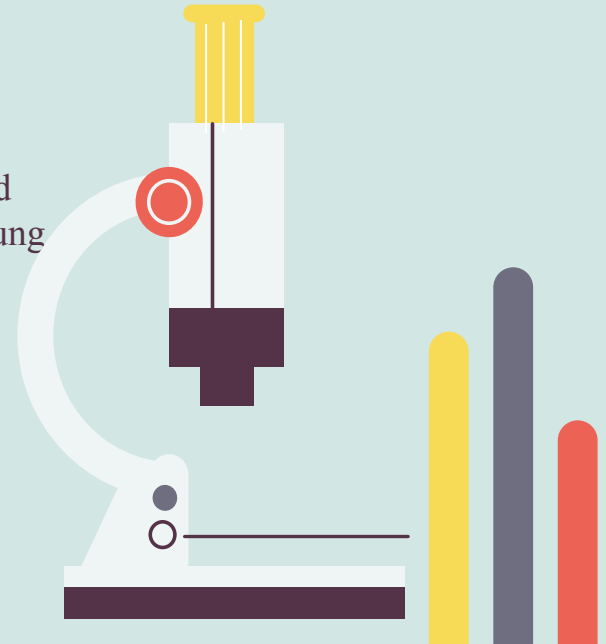
**Questioning
Stereotypes**



Addressing gender stereotypes in science is crucial for creating a more inclusive and diverse scientific community. Encouraging girls and women to pursue STEM education and careers, providing mentorship and support, and promoting policies that ensure equal opportunities for all individuals are essential steps towards breaking down these harmful stereotypes. Recognizing and challenging unconscious biases in the scientific community is also vital to fostering an environment that values and respects the contributions of women in science.

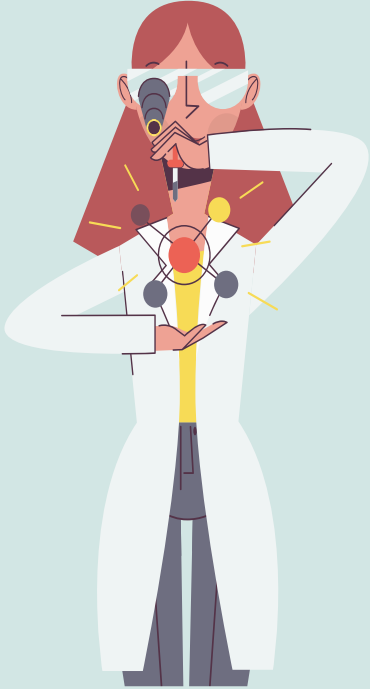
4.3. Empowering Female Students in STEM: Breaking Barriers and Pursuing Success

In recent years, there has been a growing recognition of the need for women to play a more significant role in science, technology, engineering, and mathematics (STEM) fields. However, despite progress, there is still a significant gender gap in these areas. To bridge this divide, it is crucial to encourage and empower female students to pursue challenging STEM courses in high school. This section aims to provide practical strategies and inspiration for educators, parents, and mentors to support and motivate young women in their STEM journey.



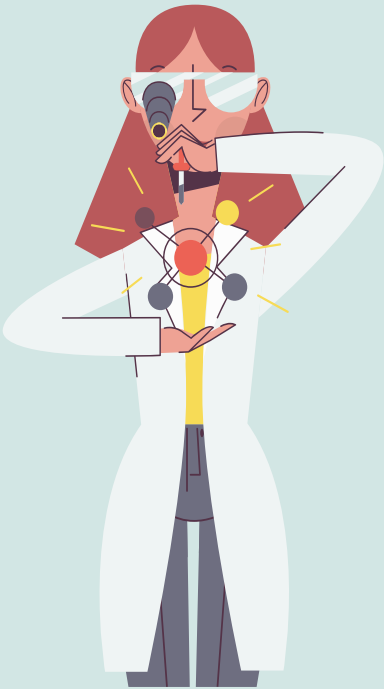
Here are some effective strategies for encouraging girls and women to pursue and excel in STEM subjects:





- **Early Exposure and Education:** Introduce girls to STEM subjects at an early age through interactive and engaging activities that showcase the fun and creativity of STEM fields. Encourage schools and educational institutions to offer inclusive and diverse STEM curricula that appeal to all students.
- **Female STEM Role Models:** Highlight and celebrate female STEM role models who have made significant contributions to their respective fields. These role models can inspire and motivate girls to envision a successful STEM career.
- **Mentorship and Support:** Establish mentorship programs where female students can connect with female professionals in STEM fields. Mentorship provides guidance, encouragement, and valuable insights into career opportunities.
- **Addressing Gender Bias and Stereotypes:** Raise awareness about gender bias and stereotypes in STEM fields and work towards eliminating them. Challenge assumptions and foster an inclusive environment that welcomes diversity.
- **Providing Access to Resources:** Ensure equal access to resources such as technology, equipment, and facilities to girls and women interested in pursuing STEM subjects.
- **Hands-On Learning and Practical Experience:** Organize workshops, hackathons, and science camps that offer hands-on learning experiences and showcase real-world applications of STEM concepts.





- **Industry Partnerships:** Collaborate with STEM-related industries and organizations to provide internships, scholarships, and job opportunities for female students and professionals.
- **Supportive Family Environment:** Engage parents and families in promoting STEM education for girls and women. Encourage parents to support their daughters' interests and aspirations in STEM fields.
- **Female-Focused STEM Events and Conferences:** Organize events and conferences specifically tailored for girls and women in STEM, where they can network, share experiences, and learn from each other.
- **Inclusive and Diverse STEM Culture:** Foster an inclusive and diverse STEM culture that values and appreciates contributions from people of all genders, backgrounds, and identities.
- **Collaboration with Non-Profit Organizations:** Partner with non-profit organizations that focus on promoting STEM education and careers for girls and women. Pool resources and efforts for greater impact.
- **Recognizing Achievements:** Recognize and celebrate the achievements of girls and women in STEM through awards, scholarships, and public recognition.

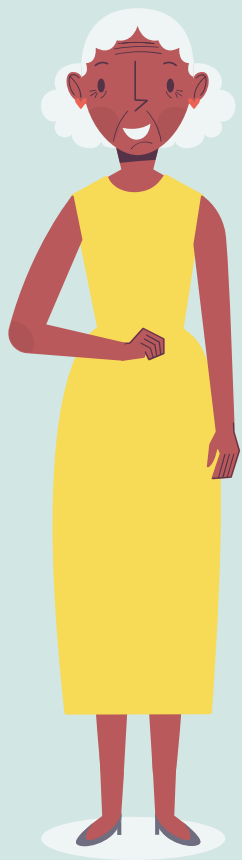
Conclusion: By implementing these strategies, we can inspire and empower more female students to pursue challenging STEM courses in high school. Remember, gender should never be a barrier to success in any field. Together, we can create an inclusive environment where all students, irrespective of their gender, have equal opportunities to thrive in the exciting world of STEM.



- **Mentoring and Role Models**
- **Establish Mentorship Programs**
- **Arrange Visits and Interactions**
- **Engage Female STEM Professionals**
- **Providing Resources and Support**
- **Offer Additional Resources**
- **Promote Scholarships and Internships**
- **Collaborate with Local Organizations**
- **Celebrating Achievements**
- **Recognize Accomplishments**
- **Showcase Exceptional Projects**
- **Encourage Sharing Success Stories**

- **Raising Awareness**
- **Organize Seminars and Workshops**
- **Collaborate with Local STEM Organizations**
- **Create Supportive Networks**
- **Addressing Stereotypes and Bias**
- **Challenge Stereotypes**
- **Encourage Open Discussions**
- **Incorporate Diverse Representations**





Now, let's talk about activities!

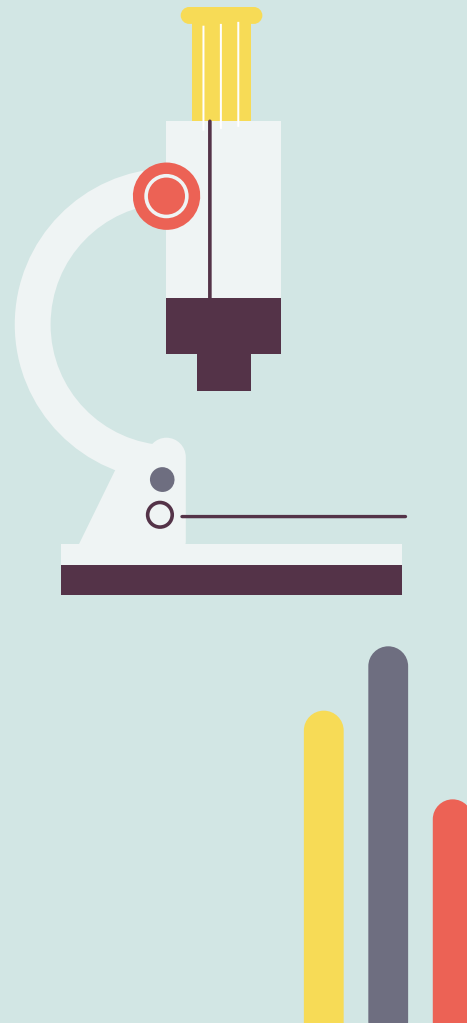


ACTIVITIES FOR STUDENTS



Let's tell the world about Women and Girls in Science!

"Women and Girls in Science"	
Age	12-18 years
Group size	5-25 pupils
Time	100-150 min
Type of activity	Storytelling, drawing, writing
Objectives	<ul style="list-style-type: none">• Enhancing students' ability to think critically regarding advertising and the media.• Engaging in exercises to foster creativity and improve communication skills.• Generating concepts to advocate for women and girls right to choose a STEM career.• Deepening comprehension of the principles and importance of human rights.
Preparation	If possible, arrange video equipment to record the advertisements.
Materials	Paper and art supplies



Instructions:

- Organize pupils into groups of five. Groups are asked to create a television advertisement that promotes STEM to girls. The ad should last between one to three minutes.
- Engage the pupils in a conversation about worldwide known women in sciences. Together, brainstorm elements that make advertisements effective, such as compelling messages, music, and a good story.
- Instruct each group to select a particular STEM subject they want to advertise and identify the relevant audience(s) for their message.
- Ask a representative from each group to present their chosen discipline and the intended audience (students, teachers, parents, community).
- Guide the groups in developing creative advertising ideas. Encourage them to explore various approaches, such as acting out a story, composing a song, or creating a storyboard for a cartoon.
- Monitor the groups' progress as they work on their advertisements. When a group completes their ad, have them give it a title and begin rehearsing.
- Gather all the groups together to share their ideas and receive feedback from one another.
- Have each group present their advertisement.

Debriefing and Evaluation: *Lead a debriefing session. Questions that can help:*

1. *What new insights did you gain about women in science?*
 2. *Why do you think girls should pursue a career in science?*
 3. *Was it difficult to find women having a STEM career?*
 4. *Women in science are typically portrayed in a positive light? Why or why not?*
 5. *What did you learn from viewing the storyboards created by other groups?*
 6. *Do you think this activity has influenced your perspective on pursuing a STEM career?*
- Through this debriefing and evaluation process, participants can reflect on their experiences, assess the effectiveness of their advertisements, and recognize the significance of raising awareness about STEM and the opportunities to chose a career in STEM.



Group Still Life


This activity can be organized as an ice-breaker or as an energizer. It challenges traditional gender roles and encourage inclusivity and can help students explore their interests in STEM fields without being constrained by societal stereotypes



"Women and Girls in Science"	
Age	12-18 years
Group size	not applicable
Time	30 min
Type of activity	energizer
Objectives	<ul style="list-style-type: none">• Encourage students to express themselves and their emotions through the objects they choose to bring and share.• Enhance students verbal communication skills.• Develop empathy and understanding towards their peers.• Create a group still life display using personal objects helps build a sense of community and belonging among the children.
Preparation	Power Point, videos.
Materials	Paper and art supplies.



Instructions:

- Discuss the importance of STEM fields and the involvement of people of all genders in these areas. Emphasize that everyone can pursue STEM interests and careers, regardless of their gender.
 - Encourage students to bring items related to STEM or professions that are often gender-stereotyped. For example, they could bring science-related tools, engineering models, technology gadgets, or mathematical puzzles.
 - Prior to the activity, present a brief discussion on gender stereotypes in STEM. Discuss how these stereotypes can limit opportunities and discourage certain individuals from pursuing their interests. Encourage the students to think critically about these stereotypes and how they can challenge them.
 - As each child presents their STEM-related item, have them talk about their interests and curiosities in STEM. Encourage them to share why they find STEM subjects fascinating and how they perceive themselves as potential contributors to these fields.
 - Arrange the STEM-related objects together to create a group still life display that highlights the diversity of interests and talents among the students. Ensure that the display represents a broad range of STEM subjects and does not conform to traditional gender roles.
 - Engage the students in a group discussion about the objects and interests represented in the still life display. Discuss how these interests can be pursued by anyone, regardless of gender, and how breaking free from stereotypes can benefit society as a whole.
- Debriefing and Evaluation:** Lead a debriefing session.
1. *What new insights did you gain after this activity?*
 2. *Why do you think it is more difficult for girls to pursue a career in science?*
 3. *What did you learn from viewing the storyboards created by other groups?*
 4. *Do you think this activity has influenced your perspective on pursuing a STEM career?*
- Through this activity, students can begin to question gender stereotypes in STEM and embrace their interests and potentials without limitations. The activity promotes inclusivity, diversity, and the understanding that anyone can excel in STEM fields, regardless of gender.
- 



Activities for students

BREAKING GENDER STEREOTYPES

QUIZZ



How to prepare and conduct scientific work?

Aim and objectives:

- Study of certain objects and phenomena.
- Familiarization with measurement techniques and statistical data analysis.
- Identification of deviations between the empirical data obtained by the student and previously established and generally accepted scientific facts and patterns.
- Identifying the causes of these deviations and analyzing the results obtained.
- Writing conclusions containing recommendations for making relevant decisions.



- I. **Title page:** Includes the title of the report, author's name, affiliation, date, and any other relevant information.
- II. **Abstract:** A concise summary of the entire report, highlighting the main objectives, methods, results, and conclusions.
- III. **Introduction:** Provides background information, the research question or objective, and the significance of the study.
- IV. **Literature Review:** Summarizes relevant previous research and its relation to your study.
- V. **Methods:** Describes the experimental design, data collection procedures, and general characteristics of the data obtained, for numerical data - primary statistics.
- VI. **Results:** Presents the findings of your study, often using tables, figures, and graphs.
- VII. **Discussion:** Interprets the results, compares them to existing knowledge, and discusses implications and limitations.
- VIII. **Conclusion:** Summarizes the key findings and their significance, along with suggestions for future research.
- IX. **References:** Cite all the sources you have referred to in the report following a specific citation style (e.g., APA, MLA, Chicago).
- X. **Applications.**

Checklist for assessing the quality of the study

Criteria&Indicators evaluation

No.	Criteria	Indicators evaluation	Criteria evaluation
1	The quality of the literature review	The work provides a detailed analysis of the degree of theoretical study of the problem, various approaches to its solution.	0 - failed, 2 - partially completed, 4 - done
2	Research apparatus	The aim and objectives of the scientific work are reasonably defined, its object and subject are indicated, the hypothesis is justified and reasonable.	0 - failed, 2 - partially completed, 4 - done
3	Research methods	Research methods and techniques correspond to the stated topic, data processing and analysis methods are correct and justified	0 - failed, 2 - partially completed, 4 – done

Checklist for assessing the quality of the study

Criteria&Indicators evaluation

No.	Criteria	Indicators evaluation	Criteria evaluation
4	Presentation of results	The results are presented in full in the form of tables, graphs and other illustrative material	0 - failed, 2 - partially completed, 4 – done
5	Interpretation of results	The results are interpreted using modern theoretical data presented in the literature. The student is able to explain the results obtained, and not just state them.	0 - failed, 2 - partially completed, 4 – done
6	Conclusions	The work results are justified. Conclusions are drawn and presented clearly.	0 - failed, 2 - partially completed, 4 – done
7	Formatting and reporting	The work is presented in accordance with the established requirements.	0 - failed, 2 - partially completed, 4 – done

Criteria for auto-evaluation:

- 24 and above - excellent
- 18–22 points - good
- 10-16 points – satisfactory

SECTION 5: HANDS-ON ACTIVITIES AND PROJECTS

01

Science Experiments

02

Coding and Programming

03

Engineering Challenges

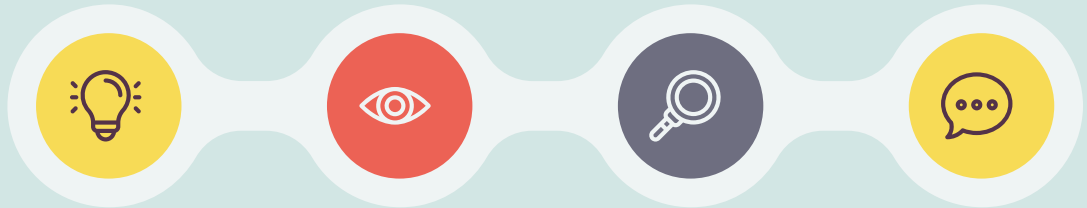
04

Maker Projects

5.1 Science Experiments

Step-by-step instructions for conducting engaging experiments in various scientific domains, fostering curiosity and critical thinking.

- Engaging students in hands-on science experiments is a powerful way to cultivate their curiosity and critical thinking skills.
- This section provides step-by-step instructions for conducting exciting experiments across various scientific domains.
- Each experiment is designed to be accessible and educational, encouraging students to explore, question, and analyze the world around them.



Experiment 1 - Chemical Reactions

Exploring the Elephant Toothpaste Reaction

Materials:

30% hydrogen peroxide solution

Yeast

Dish soap

Warm water

Food coloring (optional)

Safety goggles

Plastic bottle

Funnel

Measuring cups

Measuring spoons

Procedure:

Put on safety goggles.

In a plastic bottle, pour $\frac{1}{2}$ cup of 30% hydrogen peroxide solution.

Add a few drops of food coloring (optional) for visual effect.

In a separate cup, mix 1 tablespoon of warm water and 1 teaspoon of yeast.

Stir the yeast mixture until it dissolves.

Quickly pour the yeast mixture into the plastic bottle using a funnel.

Immediately add a few drops of dish soap to the bottle.

Observe the foamy eruption and discuss the chemical reaction involved.



Experiment 2 - Physics

Investigating the Forces of Friction

Materials:

Smooth wooden or plastic surface
Objects of different weights (e.g., toy cars, books)
Spring scale
Stopwatch or timer
Measuring tape or ruler

Procedure:

Place the wooden or plastic surface on a flat table.
Select an object and place it on the surface.
Attach the spring scale to the object and pull it slowly until it starts to move.
Record the force required to overcome static friction.
Measure the distance the object travels before stopping.
Repeat steps 2-5 with different objects and record your observations.
Analyze the relationship between weight, force, and distance traveled.

Experiment 3 - Biology

Investigating Photosynthesis with Elodea

Materials:

Elodea (aquatic plant)
Water
Baking soda
Clear container or test tube
Light source
Stopwatch or timer

Procedure:

Fill the container with water and add a pinch of baking soda to provide carbon dioxide.
Place a healthy sprig of Elodea in the container, ensuring it is fully submerged.
Position the container near a light source.
Start the timer and observe the Elodea for 10-15 minutes.
Record any changes in the Elodea's appearance, such as the release of bubbles.
Discuss the process of photosynthesis and how the Elodea utilizes light energy.

CONCLUSIONS

Engaging students in these science experiments fosters their curiosity and critical thinking abilities.

These experiments serve as valuable tools to enhance their understanding and appreciation of scientific concepts.



By providing step-by-step instructions in various scientific domains, students are encouraged to explore, question, and analyze the world around them.

WEBSITES

Here are a few websites where you can find free web examples of science experiments with step-by-step instructions:








1. **Exploratorium**
2. **Science Buddies**
3. **Steve Spangler Science**
4. **NASA's Climate Kids**
5. **Science Kids**



WEBSITES

Here are a few websites where you can find free web examples of science experiments with step-by-step instructions:

- 
- NASA's Climate Kids:** NASA's Climate Kids website offers science experiments related to climate change and Earth science. You can find a range of experiments with detailed instructions at <https://climatekids.nasa.gov/menu/experiment/>.
- 
- Steve Spangler Science:** Steve Spangler Science is known for its captivating and hands-on experiments. They have a dedicated section on their website called "Experiment Library" where you can find step-by-step instructions for conducting various experiments. Visit <https://www.stevespanglerscience.com/experiments/> to explore their collection.
- 
- Exploratorium:** The Exploratorium offers a variety of science experiments across different domains. Visit their website at <https://www.exploratorium.edu/explore> and search for "science experiments" to find a range of engaging experiments with detailed instructions.
- 
- Science Kids:** Science Kids provides a wide range of experiments for kids of all ages. Their website at <https://www.sciencekids.co.nz/experiments.html> offers step-by-step instructions and videos for conducting experiments in various scientific domains.
- 
- Science Buddies:** Science Buddies provides a vast collection of science experiments for students of all ages. You can explore their experiments library at <https://www.sciencebuddies.org/> and filter results based on grade level, topic, and duration to find experiments that suit your needs.

5.2. Coding and Programming



Resources for learning programming languages (e.g., Python, Java, HTML) and interactive coding projects to develop computational thinking skills.

Coding, also known as **programming**, is the process of giving instructions to a computer to perform specific tasks. It involves writing lines of code in programming languages such as Python, Java, or C++.

These languages allow us to communicate with computers and create software, websites, apps, and much more.

Now, you might be wondering why coding is important. Well, in today's digital age, coding skills are becoming increasingly valuable and sought after. Here are a few reasons why learning to code can benefit you:



Learning code benefits



Problem-solving skills

Computational thinking

Career opportunities

Creativity and innovation

Coding requires analytical thinking and problem-solving abilities. It helps you break down complex problems into smaller, manageable parts and find creative solutions.

Coding teaches you how to think logically and systematically. It enhances your ability to organize and analyse data, which can be applied to various real-life situations.

The demand for skilled programmers is continuously growing in various industries like technology, gaming, finance, and healthcare. By learning to code, you open up a wide range of career possibilities.

Coding allows you to bring your ideas to life. You can create your own websites, develop mobile apps, or design games. It's a fantastic outlet for expressing your creativity and turning your imagination into reality.

Begin coding journey

Now that you understand the importance of coding, let's discuss how you can get started. Here are a few steps to begin your coding journey:

- 1. Choose a programming language:** Start by selecting a programming language to begin with. Python is often recommended for beginners due to its simplicity and readability, but other popular languages include JavaScript, Java, and C++.
- 2. Find learning resources:** There are plenty of online platforms, tutorials, and coding courses available to help you get started. Websites like Codecademy, FreeCodeCamp, and Coursera offer interactive coding lessons and projects.

```
1 <!DOCTYPE html>
2 <html lang="en">
3 <head>
4   <meta charset="UTF-8">
5   <meta name="viewport" content="width=device-width, initial-scale=1.0">
6   <title>Your Page Title</title>
7 </head>
8 <body>
9   <h1>Hello, World!</h1>
10  <p>This is a sample HTML document.</p>
11 </body>
12 </html>
```

- 3. Practice, practice, practice:** The key to becoming a proficient coder is consistent practice. Set aside dedicated time to code regularly. Solve coding challenges, work on small projects, and experiment with different coding concepts.
- 4. Join coding communities:** Engage with other coders by joining online coding communities or forums. Participate in coding competitions or hackathons to challenge yourself and learn from others.
- 5. Build projects:** Apply your coding skills by working on projects that interest you. It could be creating a simple website, developing a game, or building a mobile app. Hands-on projects enhance your understanding and showcase your abilities.

OERs on Coding and Programming

Remember, learning to code is a journey that requires patience and persistence. Embrace the challenges, celebrate your accomplishments, and never stop exploring new coding concepts.

So, are you ready to embark on this exciting coding adventure? Start small, dream big, and let your imagination soar. Happy coding, high school students!



Codecademy
FreeCodeCamp
Khan Academy
W3Schools
Coursera
Udemy
MIT OpenCourseWare
CodingBat
Scratch
Code.org



WEBSITES

Here are some OERs on Coding and Programming



Codecademy: Codecademy offers interactive coding courses in various programming languages, including Python, Java, HTML, and many more. It provides a hands-on learning experience with exercises and projects.



FreeCodeCamp: FreeCodeCamp is a platform that offers free coding courses in web development. It covers HTML, CSS, JavaScript, and more. It also provides coding challenges and projects to practice and enhance skills.



Khan Academy: Khan Academy offers a wide range of programming courses for beginners and advanced learners. It covers languages like HTML, CSS, JavaScript, and also provides computer science fundamentals.



W3Schools: W3Schools is an excellent resource for learning web development languages like HTML, CSS, JavaScript, and more. It provides interactive examples, quizzes, and tutorials to help learners grasp the concepts effectively.



Coursera: Coursera offers online courses taught by top instructors from renowned universities. It has programming language courses like Python, Java, and more. These courses include video lectures, quizzes, and coding assignments.

WEBSITES

Here are some OERs on Coding and Programming



Udemy: Udemy is an online learning platform that offers a vast range of programming courses. It covers various languages, including Python, Java, HTML, and more. Udemy courses are self-paced, allowing learners to learn at their convenience.



MIT OpenCourseWare: MIT OpenCourseWare provides free access to course materials from MIT's undergraduate and graduate-level courses. It includes programming courses like Introduction to Computer Science and Programming in Python, offering lecture notes, assignments, and exams.



CodingBat: CodingBat is a website that offers coding exercises and practice problems in Python and Java. It provides instant feedback and hints to help learners improve their coding skills.



Scratch: Scratch is a visual programming language developed by MIT. It is designed for beginners and helps develop computational thinking skills through interactive coding projects. Scratch's drag-and-drop interface makes it easy to create animations, games, and interactive stories.



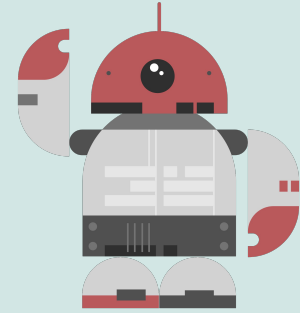
Code.org: Code.org is an online platform that offers coding courses for different age groups. It provides a variety of programming languages and interactive coding activities to enhance computational thinking skills.

5.3. Engineering Challenges

Design-based projects that encourage students to apply engineering principles to solve real-world problems.

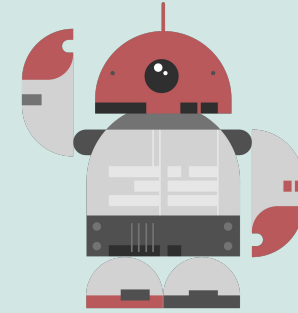


5.3. Engineering Challenges



1. **Build a bridge:** Students are tasked with designing and constructing a bridge using limited materials such as popsicle sticks, straws, and tape. The bridge should be able to support a specified weight and span a given distance.
2. **Create a water filtration system:** Students must design and build a system that can filter dirty water and make it safe to drink. They will need to consider factors such as cost, efficiency, and effectiveness.
3. **Design a wind turbine:** Students are challenged to create a wind turbine that can generate the most electricity using limited resources. They must consider factors such as blade design, wind speed, and turbine height.
4. **Construct a catapult:** Students will design and build a catapult that can launch a projectile the farthest distance. They will need to consider factors such as tension, angle, and projectile weight.
5. **Develop a solar-powered vehicle:** Students must design and build a small vehicle that runs solely on solar power. They will need to consider factors such as energy conversion, efficiency, and weight.

More Engineering Challenges



- 1. Design a sustainable building:** Students are tasked with designing a building that incorporates sustainable features such as solar panels, rainwater harvesting systems, and green roofs. They will need to consider factors such as energy efficiency, materials, and aesthetics.
- 2. Create a prosthetic limb:** Students will design and build a functional prosthetic limb for a specific amputation level. They will need to consider factors such as comfort, range of motion, and durability.
- 3. Build a Rube Goldberg machine:** Students must design and construct a complex machine that performs a simple task through a series of chain reactions. They will need to consider factors such as energy transfer, motion, and timing.
- 4. Construct a roller coaster:** Students will design and build a roller coaster that includes loops, twists, and turns. They will need to consider factors such as gravity, friction, and velocity.
- 5. Design a sustainable transportation system:** Students are challenged to create a transportation system that reduces traffic congestion and minimizes environmental impact. They will need to consider factors such as infrastructure, energy efficiency, and public transportation options.

WEBSITES

Here are some OERs on Engineering Challenges



MIT OpenCourseWare - "Design and Manufacturing I" (<https://ocw.mit.edu/courses/mechanical-engineering/2-007-design-and-manufacturing-i-spring-2009/>): This course provides resources for design projects that involve the application of engineering principles to solve real-world problems. It includes lecture notes, assignments, and project descriptions.



Engineering Design Process - "Design Challenges" (<https://www.engineeringdesignprocess.net/design-challenges.html>): This website offers a collection of design challenges that can be used to engage students in applying engineering principles to solve real-world problems. Each challenge includes background information, design criteria, and suggested materials.



TeachEngineering - "Design-based Projects" (<https://www.teachengineering.org/activities/designprojects>): TeachEngineering offers a wide range of design-based projects that encourage students to apply engineering principles. The projects are categorized by grade level and cover various topics such as renewable energy, transportation, and environmental engineering.



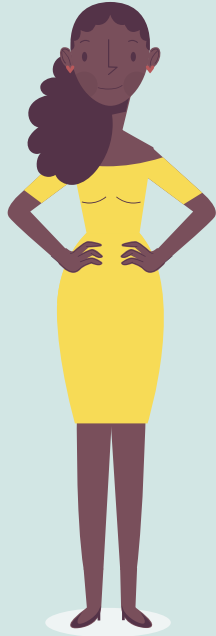
National Science Foundation - "Engineering Design Challenges" (<https://www.nsf.gov/news/classroom/engineering.jsp>): The National Science Foundation provides a list of engineering design challenges for students. These challenges are designed to promote problem-solving skills and the application of engineering principles in real-world scenarios.



PBLWorks - "Engineering Design Projects" (<https://www.pblworks.org/what-is-pbl/engineering-design-projects>): PBLWorks offers a collection of engineering design projects that integrate science, technology, engineering, and mathematics (STEM) concepts. These projects involve real-world problems and provide resources for teachers to facilitate student learning.

5.4. MAKER PROJECTS

DIY activities that promote creativity and innovation, utilizing tools like 3D printers, Arduino, Raspberry Pi, and electronics.



Unleash Your Creativity: Dive into the Exciting World of Maker Projects!

Welcome to the fascinating realm of Maker Projects! In this section, we will introduce you to a wide range of Do-It-Yourself (DIY) activities that promote creativity, innovation, and hands-on learning. By harnessing the power of tools such as 3D printers, Arduino, Raspberry Pi, and electronics, you'll have the opportunity to explore your interests, develop essential skills, and bring your imaginations to life.

DIY activities promote creativity and innovation, utilizing tools like 3D printers, Arduino, Raspberry Pi, and electronics.

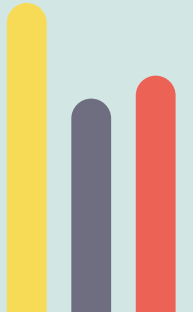
Unleash Your Creativity: Dive into the Exciting World of Maker Projects!

Understanding Maker Projects



- **What are Maker Projects?**

Maker Projects refer to hands-on, do-it-yourself activities that encourage individuals to design, create, and innovate using a variety of tools and materials. These projects often involve technology, such as 3D printers, microcontrollers, and programming software, but can also incorporate traditional crafting materials like wood, fabric, or paper.



Benefits of Engaging in Maker Projects



Encourages Creativity: Maker Projects provide an outlet for creativity, enabling individuals to explore their ideas and express themselves through hands-on creation. This fosters the development of critical thinking skills and encourages innovative problem-solving.



Enhances STEM Skills: Maker Projects often incorporate science, technology, engineering, and mathematics (STEM) principles. By engaging in these projects, participants can develop a deeper understanding of these subjects, as well as enhance their skills in areas such as coding, electronics, and prototyping.



Promotes Collaboration: Maker Projects emphasize collaboration and teamwork. Participants often work together, sharing ideas, skills, and resources to bring their projects to fruition. This collaborative environment encourages communication, cooperation, and the exchange of knowledge and expertise.



Builds Resilience and Perseverance: Maker Projects are not always easy, and participants may encounter challenges along the way. However, these projects teach resilience and perseverance, as individuals learn to overcome obstacles, troubleshoot problems, and adapt their designs to achieve their goals.



Essential Tools and Technologies

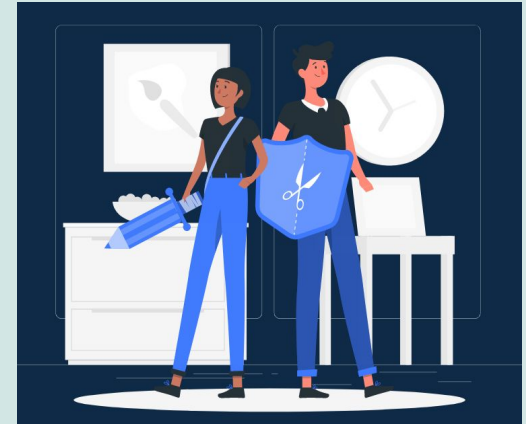
In today's rapidly advancing technological landscape, it is essential for students to be acquainted with various tools and technologies that can enhance their learning experiences. This section introduces some of the key tools and technologies that are revolutionizing the field of education and empowering students to explore and create.

3D Printers: Unlocking the Power of Prototyping

Arduino: Building Interactive and Programmable Devices

Raspberry Pi: Unleashing the Potential of Computing and Electronics

Electronics: Circuitry, Sensors, and Components



Essential Tools and Technologies

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3D Printers: Unlocking the Power of Prototyping

3D printers have emerged as a game-changer in the world of design and innovation. These machines allow students to transform their digital designs into tangible objects by layering materials and creating three-dimensional models. The ability to prototype and produce physical objects opens up endless possibilities for students to explore and experiment with ideas across various disciplines, from engineering and architecture to art and biology. By witnessing the transformation of their ideas into real objects, students can gain a deeper understanding of concepts, problem-solving, and design thinking.

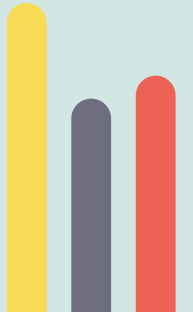


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Arduino: Building Interactive and Programmable Devices

Arduino is an open-source electronics platform that enables students to create interactive and programmable devices. With Arduino boards and software, students can learn the fundamentals of electronics and coding while designing and building their own projects. Whether it's a simple temperature sensor or a complex robotic arm, Arduino provides a hands-on approach to learning electronics, programming, and computational thinking skills. By combining creativity with technical knowledge, students can develop their problem-solving abilities and gain practical experience in the exciting world of robotics and automation



Essential Tools and Technologies

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Raspberry Pi: Unleashing the Potential of Computing and Electronics

Raspberry Pi is a small, affordable, and versatile computer that has revolutionized the world of education. With its capability to run various operating systems and support a wide range of programming languages, Raspberry Pi allows students to explore the realms of coding, computing, and electronics. By connecting peripherals and sensors to the Raspberry Pi, students can create projects that involve data collection, automation, and even Internet of Things (IoT) applications. Raspberry Pi empowers students to delve deeper into the world of computer science, computational thinking, and problem-solving, opening up doors to innovative ideas and projects.

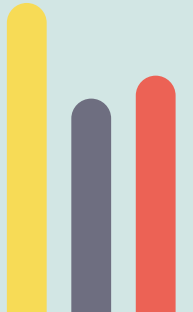


Essential Tools and Technologies

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Electronics: Circuitry, Sensors, and Components

Understanding the fundamental principles of electronics is becoming increasingly important in our technology-driven world. In this digital age, students need a foundational knowledge of circuitry, sensors, and electronic components to navigate and innovate in various fields. By learning about circuitry, students can explore how electricity flows and interacts with different components to create functional systems. By incorporating sensors, students can collect and analyze real-world data, enabling them to develop solutions for practical problems. Familiarity with electronic components such as resistors, capacitors, and transistors allows students to build and troubleshoot electronic circuits. Through hands-on experimentation, students can develop critical thinking, problem-solving, and logical reasoning skills, preparing them for the challenges of our increasingly connected world



INSPIRING MAKER PROJECT IDEAS

In this section, we will explore some exciting maker project ideas that can inspire creativity and hands-on learning. These projects involve various aspects of technology, such as electronics, programming, and 3D printing, and can be great for both beginners and more advanced makers.

- **Building a Smart Home Automation System using Arduino and Raspberry Pi**
- **Designing and Printing Customized 3D Objects**
- **Creating Wearable Tech: LED Bracelets, Smartwatches, and more**
- **Constructing Robots: From Simple Bots to Advanced Mechanisms**



INSPIRING MAKER PROJECT IDEAS

- **Building a Smart Home Automation System using Arduino and Raspberry Pi**

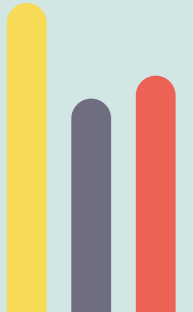
This project involves creating a home automation system that allows you to control various devices and appliances remotely. By using Arduino and Raspberry Pi, you can build a system that can control lights, temperature, security systems, and more. This project combines electronics, programming, and networking skills to create a smart home setup.



INSPIRING MAKER PROJECT IDEAS

- **Designing and Printing Customized 3D Objects**

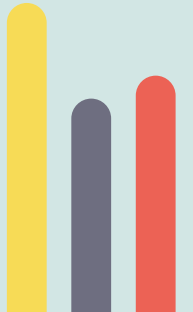
With the advent of 3D printing, it has become easier than ever to bring your own designs to life. This project involves designing and printing customized objects using CAD software and a 3D printer. You can create anything from personalized phone cases to mini sculptures. It's a great way to learn about design principles, prototyping, and bringing ideas to reality.



INSPIRING MAKER PROJECT IDEAS

- **Creating Wearable Tech: LED Bracelets, Smartwatches, and more**

Wearable technology has become increasingly popular, and this project allows you to explore the world of wearable tech. You can design and create LED bracelets that light up in different patterns, or even build your own smartwatch. This project combines electronics, programming, and fashion design to create functional and fashionable wearable devices.



INSPIRING MAKER PROJECT IDEAS

- **Constructing Robots: From Simple Bots to Advanced Mechanisms**

Robotics is a fascinating field that combines mechanics, electronics, and programming. This project involves constructing robots of varying complexities, starting from simple robots that move and avoid obstacles, to more advanced ones that can perform specific tasks. It's a great opportunity to learn about motors, sensors, programming languages like Arduino or Python, and problem-solving skills.



OERs

Here are some **Open Educational Resources (OERs)** that offer **Maker Projects and DIY activities promoting creativity and innovation using tools like 3D printers, Arduino, Raspberry Pi, and electronics:**



Instructables - Instructables is a platform that provides step-by-step instructions for a wide range of DIY projects, including those related to makerspaces and electronics. You can find projects utilizing 3D printers, Arduino, Raspberry Pi, and more. (Website: <https://www.instructables.com/>)



Adafruit Learning System - Adafruit offers a learning platform with tutorials and guides for electronics and DIY projects. They have a dedicated section for projects using Arduino, Raspberry Pi, 3D printing, and other tools. (Website: <https://learn.adafruit.com/>)



Make: Magazine - Make: offers a range of maker projects and resources, including their online magazine and project library. They cover various aspects of DIY, from electronics to coding and 3D printing. (Website: <https://makezine.com/>)



Open Electronics - Open Electronics provides open-source project tutorials and articles on electronics, robotics, and DIY activities. They have a section specifically dedicated to Arduino and Raspberry Pi projects. (Website: <https://www.open-electronics.org/>)



Raspberry Pi Foundation - The Raspberry Pi Foundation offers educational resources, including projects and tutorials for their single-board computer, the Raspberry Pi. They cover topics from basic coding to robotics and home automation. (Website: <https://www.raspberrypi.org/resources/>)



Thingiverse - Thingiverse is a popular platform for sharing 3D printable models and designs. You can find a wide range of projects and designs that utilize 3D printers and other maker tools. (Website: <https://www.thingiverse.com/>)

ACTIVITIES FOR STUDENTS

How to Prepare and Conduct Scientific Work



SECTION 6: SCHOLARSHIP & FINANCIAL AID

01

Selecting appropriate STEM electives and extracurricular activities

02

Benefits of participating in STEM-related clubs, competitions, and research opportunities

03

A directory of student-led STEM clubs, associations, and organizations to foster collaboration and networking opportunities

04

College and University Programs

6.1 Selecting appropriate STEM electives and extracurricular activities.



When selecting STEM (Science, Technology, Engineering, and Mathematics) electives and extracurricular activities, it's important to consider your interests, goals, and future career aspirations. Here are some guidelines to help you make the right choices:

- 1. Assess your interests and strengths:** Start by identifying your areas of interest within STEM. Are you more inclined towards biology, computer science, engineering, or mathematics? Understand your strengths and preferences to make informed decisions.
- 2. Research career pathways:** Explore various STEM career options and the skills required for each. This will give you a sense of which electives and activities align with your desired future profession. For example, if you aspire to be a software engineer, computer science electives and coding clubs would be beneficial.
- 3. Seek advice from mentors and teachers:** Consult your teachers, counselors, or mentors who can provide guidance based on their expertise and experience. They can help you understand the relevance and potential benefits of different electives and activities.
- 4. Consider prerequisites:** Some STEM electives may have prerequisites or recommended prior knowledge. Make sure to review these requirements to ensure you have the necessary foundation before enrolling in advanced courses.
- 5. Explore interdisciplinary options:** Look for electives and activities that bridge multiple STEM fields. For instance, robotics combines elements of engineering, computer science, and physics. This allows you to gain a broader perspective and develop versatile skills.



6.1 Selecting appropriate STEM electives and extracurricular activities.



5. Balance your workload: Consider your existing academic workload and extracurricular commitments. Ensure you have enough time and energy to dedicate to your chosen STEM electives and activities without overwhelming yourself.

6. Seek real-world application: Look for electives and activities that offer hands-on experiences and real-world applications. This can include participating in science competitions, joining research projects, or taking part in STEM-focused community service.

7. Explore internships and summer programs: Check if there are any internships or summer programs available in your area of interest. These opportunities can provide practical experience, networking opportunities, and a deeper understanding of your chosen field.

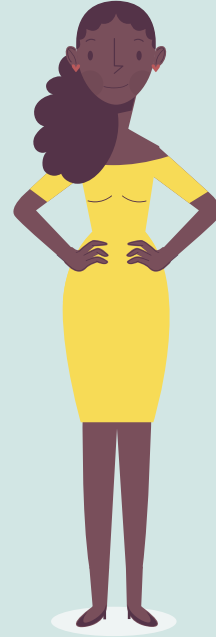
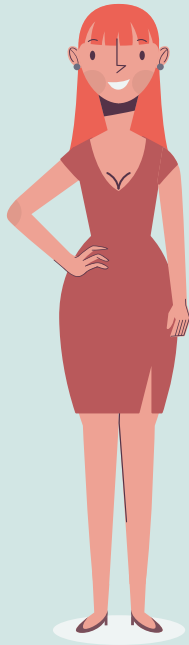
8. Join STEM clubs and organizations: Participating in STEM clubs or organizations can enhance your learning experience and foster a sense of community. This can include clubs like math clubs, coding clubs, or science Olympiad teams.

9. Pursue personal interests: Lastly, don't forget to pursue STEM electives and activities that genuinely excite you. Enjoying what you do will not only make the learning experience more enjoyable but also help you excel in your chosen field.



Remember, the goal is to select STEM electives and activities that align with your interests, goals, and future career aspirations. By following these guidelines, you can make informed decisions and make the most of your educational journey.

6.2 Benefits of participating in STEM-related clubs, competitions, and research opportunities.



Participating in STEM-related clubs, competitions, and research opportunities can bring numerous benefits to students. Here are some key advantages:



Hands-on learning: These activities provide students with practical, experiential learning opportunities. They allow students to apply theoretical knowledge to real-world situations, fostering a deeper understanding of STEM concepts.

Skill development: Engaging in STEM clubs, competitions, and research develops a range of valuable skills. Students enhance their critical thinking, problem-solving, and analytical abilities. They also improve their communication, teamwork, and time management skills.

Exploration of career pathways: Participation in these activities exposes students to various STEM fields, helping them explore different career options. Through hands-on experiences, students can discover their interests and passions, gaining insight into potential future career paths.

Networking opportunities: STEM-related clubs and competitions often connect students with like-minded peers, mentors, and professionals. Building a strong network of individuals in the STEM field can open doors to internships, job opportunities, and collaborations in the future.

Building confidence: Engaging in STEM activities allows students to gain confidence in their abilities. Overcoming challenges, presenting research findings, and competing with peers can boost self-esteem and belief in one's capabilities.



College and scholarship opportunities: Participation in STEM clubs, competitions, and research increases the chances of being recognized by colleges and universities. Admissions committees often value students who demonstrate a genuine interest and commitment to STEM fields. Additionally, many scholarships and grants are available specifically for students involved in STEM-related activities.

Research experience: Engaging in research opportunities allows students to delve deeper into a specific area of interest. They learn research methodologies, data analysis techniques, and experimental design, which are crucial skills for academic and professional success in STEM fields.

Exposure to cutting-edge technology: Many STEM clubs, competitions, and research opportunities provide access to state-of-the-art equipment and technologies. Students can explore and work with advanced tools, software, and equipment, gaining a competitive edge and staying updated with the latest advancements in their respective fields.

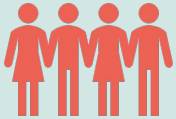
Personal growth and leadership development: Being part of STEM clubs and competitions gives students the chance to take on leadership roles, organize events, and mentor others. These experiences foster personal growth, enhancing their leadership, organizational, and interpersonal skills.



Overall, participating in STEM-related clubs, competitions, and research opportunities offers a multifaceted learning experience that enhances academic, professional, and personal growth. It equips students with the skills, knowledge, and exposure needed to thrive in the ever-evolving STEM fields.

6.3 A directory of student-led STEM clubs, associations, and organizations to foster collaboration and networking opportunities.

STEM Clubs and Organizations in Europe



1. European Student Union for Science and Technology (ESAST): ESAST is a student-led organization that brings together STEM clubs and associations from universities across Europe. It provides a platform for collaboration, networking, and sharing of resources and ideas. Visit their website to find a list of member organizations and contact information.

2. European Association of Students of Industrial Engineering and Management (ESTIEM): ESTIEM is a network of students studying industrial engineering and management. They organize events, competitions, and workshops to enhance students' technical skills and promote international cooperation. Check their website for local chapters and how to get involved.


STEM Clubs and Organizations in Europe

3. Junior Engineers, Technicians, and Scientists (JETS): JETS is a non-profit organization that encourages young people to pursue careers in STEM fields. They offer STEM programs, competitions, and events for students aged 11-18. Visit their website to find local chapters and activities in your area.

4. European Association of Geoscientists and Engineers (EAGE) Student Chapters: EAGE promotes the development and application of geosciences and engineering in Europe. They have student chapters in various universities, offering networking opportunities, workshops, and conferences. Check their website for a list of chapters and their activities.

5. European Students of Industrial Pharmacy (ESIP): ESIP is an association of pharmacy students with a focus on industrial pharmacy. They organize conferences, workshops, and networking events to enhance students' knowledge and career prospects in the pharmaceutical industry. Visit their website to find local chapters and how to join.






Mentorship and Volunteering: Guidance on seeking mentorship from professionals in STEM fields and volunteering opportunities to gain practical experience.

1. STEM Professionals Mentorship Program: This program connects students with professionals in STEM fields who can provide guidance, advice, and support. Visit their website to learn more about the program and how to apply.

2. Professional Associations: Many professional associations in STEM fields offer mentorship programs for students. Examples include the Institute of Electrical and Electronics Engineers (IEEE), the European Molecular Biology Organization (EMBO), and the European Physical Society (EPS). Visit their websites to explore mentorship opportunities.



Volunteering Opportunities in Europe

- 3. European Voluntary Service (EVS):** EVS is a program funded by the European Commission that offers volunteering opportunities in various fields, including STEM education and research. Check their website for available projects and how to apply.
- 4. STEM Outreach Programs:** Many universities and research institutions organize STEM outreach programs, where volunteers can assist in organizing workshops, science fairs, and mentoring students. Contact local universities or research institutions to inquire about volunteering opportunities.
- 5. Non-profit Organizations and Community Centers:** Non-profit organizations and community centers often offer STEM-related programs for underprivileged students. Volunteering with these organizations can provide practical experience in STEM education and mentoring. Research local organizations and reach out to inquire about volunteer opportunities.



6.4 Information on STEM-related undergraduate programs, scholarships, and internships in each partner country.

ITALY - PORTUGAL - SPAIN - BULGARIA - ROMANIA

Italy

Italy offers a wide range of STEM-related undergraduate programs, scholarships, and internships for students interested in pursuing a career in science, technology, engineering, and mathematics. Here is some information on these opportunities:

Undergraduate Programs:

- **Politecnico di Milano:** Known for its engineering and architecture programs, Politecnico di Milano offers a variety of undergraduate programs in STEM fields.
- **University of Bologna:** This university offers a range of STEM-related undergraduate programs, including computer science, physics, chemistry, and mathematics.
- **University of Padua:** The University of Padua offers undergraduate programs in areas such as biotechnology, biomedical engineering, physics, and computer science.
- **University of Rome La Sapienza:** This university offers a wide range of STEM-related undergraduate programs, including computer engineering, physics, mathematics, and chemistry.



Italy

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Scholarships:

- **Italian Government Scholarships for International Students:** The Italian government offers scholarships to international students, including those studying STEM fields. These scholarships cover tuition fees, accommodation, and a monthly stipend.
- **EDISU Piemonte Scholarships:** EDISU Piemonte provides scholarships to students studying in universities and institutions located in the Piedmont region. They offer scholarships for STEM-related programs.
- **University-specific Scholarships:** Many Italian universities offer their own scholarships for international students. Check with the universities you are interested in for specific scholarship opportunities.



Italy

Italy offers a wide range of STEM-related undergraduate programs, scholarships, and internships for students interested in pursuing a career in science, technology, engineering, and mathematics. Here is some information on these opportunities:

Internships:

- **Leonardo da Vinci Program:** This program provides internships in various fields, including STEM, for students from European Union countries.
- **IAESTE Italy:** IAESTE (International Association for the Exchange of Students for Technical Experience) offers internships in STEM-related fields in Italy for students from participating countries.
- **Company-Specific Internships:** Many Italian companies, particularly in the technology and engineering sectors, offer internships to students. Check with specific companies or industry associations for internship opportunities.

It's important to research and reach out to individual universities, scholarship providers, and companies for more detailed information on the application processes, eligibility criteria, and deadlines for these programs, scholarships, and internships.



Portugal

Portugal offers a range of STEM-related undergraduate programs, scholarships, and internships for students interested in pursuing a career in these fields. Here is some information to help you navigate these opportunities.

Undergraduate Programs:

- **Instituto Superior Técnico (IST):** IST is a renowned institution offering various engineering and science undergraduate programs. They offer programs in areas such as Aerospace Engineering, Biomedical Engineering, Computer Science, Electrical Engineering, and more. Website: <https://tecnico.ulisboa.pt/en/>
- **University of Porto:** The University of Porto provides a wide range of STEM-related undergraduate programs, including Computer Science, Electrical Engineering, Chemical Engineering, Mathematics, and Physics. Website: <https://sigarra.up.pt/up/pt/>
- **University of Lisbon:** The University of Lisbon offers undergraduate programs in various STEM fields, such as Computer Science, Physics, Mathematics, Biotechnology, and Environmental Engineering. Website: <https://www.ulisboa.pt/>



Portugal

Portugal offers a range of STEM-related undergraduate programs, scholarships, and internships for students interested in pursuing a career in these fields. Here is some information to help you navigate these opportunities.

Scholarships:

- **Calouste Gulbenkian Foundation:** The foundation offers scholarships for undergraduate studies, including those in STEM fields. The scholarships aim to support talented and motivated students with financial need. Website: <https://gulbenkian.pt/en/>
- **Santander Universities:** Santander Universities collaborates with different Portuguese universities to provide scholarships for various academic levels. They specifically offer scholarships for STEM-related fields. Website: <https://www.santander.pt/>



Portugal

Portugal offers a range of STEM-related undergraduate programs, scholarships, and internships for students interested in pursuing a career in these fields. Here is some information to help you navigate these opportunities.

Internships:

- **MIT Portugal Program:** This program offers internships for students in collaboration with Portuguese universities and the Massachusetts Institute of Technology (MIT). The internships focus on research and development in areas like Engineering Systems, Sustainable Energy Systems, Bioengineering, and more. Website: <https://www.mitportugal.org/>
- **INESC TEC:** INESC TEC is an R&D institute that offers internships in areas such as Artificial Intelligence, Robotics, Data Science, and Energy. They collaborate with universities and industry partners to provide valuable work experience to students. Website: <https://www.inesctec.pt/en>
- **Fraunhofer Portugal:** Fraunhofer Portugal is an applied research institution that offers internships in areas like Information and Communication Technologies, Renewable Energies, and Industrial Engineering. Website: <https://www.fraunhofer.pt/>

It's important to note that availability and application deadlines for scholarships and internships may vary each year. It's recommended to visit the respective websites for up-to-date information and application procedures.



Spain

Spain offers a variety of STEM-related undergraduate programs, scholarships, and internships for students interested in pursuing a career in science, technology, engineering, or mathematics. Here is some information on these opportunities.

Undergraduate Programs:

- **Bachelor's Degree in Computer Science and Engineering:** This program focuses on computer software, hardware, and systems. It provides students with a strong foundation in programming, algorithms, databases, and computer networks.
- **Bachelor's Degree in Biotechnology:** This program combines biology, chemistry, and engineering principles to develop new technologies and applications in healthcare, agriculture, and environmental science.
- **Bachelor's Degree in Industrial Engineering:** This program covers a wide range of engineering disciplines, including mechanics, electricity, electronics, and materials science. It prepares students for careers in manufacturing, energy, transportation, and logistics.



Bachelor's Degree in Physics: This program provides a comprehensive understanding of fundamental physics principles, including mechanics, electromagnetism, thermodynamics, and quantum mechanics. It is suitable for students interested in research or teaching careers.



Spain

Spain offers a variety of STEM-related undergraduate programs, scholarships, and internships for students interested in pursuing a career in science, technology, engineering, or mathematics. Here is some information on these opportunities.

Scholarships:

- **Erasmus+ Scholarships:** The Erasmus+ program offers scholarships for students to study abroad within Europe, including Spain. These scholarships cover tuition fees, travel expenses, and living costs.
- **Spanish Government Scholarships:** The Spanish government provides scholarships for international students pursuing undergraduate studies in Spain. These scholarships are awarded based on academic merit and financial need.



Spain

Spain offers a variety of STEM-related undergraduate programs, scholarships, and internships for students interested in pursuing a career in science, technology, engineering, or mathematics. Here is some information on these opportunities.

Internships:

- **Leonardo Da Vinci Internship Program:** This program offers internships in various STEM fields for European students. It provides an opportunity to gain practical experience and develop professional skills in a Spanish company or research institution.
- **University Internship Programs:** Many universities in Spain have internship programs that connect students with local companies and organizations. These internships allow students to apply their knowledge in real-world settings and build professional networks.
- **Industry-Specific Internship Programs:** Some industries, such as technology and engineering, offer specific internship programs for students. These programs provide hands-on experience and often lead to job opportunities after graduation.

It's important to note that specific program details, eligibility criteria, and application processes may vary. Students are advised to visit the websites of the universities, scholarship providers, and internship programs for the most up-to-date information.

Bulgaria

Bulgaria offers a variety of STEM-related undergraduate programs, scholarships, and internships for students interested in pursuing a career in science, technology, engineering, or mathematics. Here is some information on these opportunities.

Undergraduate Programs:

- **Sofia University "St. Kliment Ohridski"** - Faculty of Mathematics and Informatics: Offers undergraduate programs in mathematics, computer science, and informatics. They also provide scholarships and internships opportunities for students in collaboration with industry partners.
- **Technical University of Sofia** - Faculty of Electrical Engineering and Electronics: Offers undergraduate programs in electrical engineering, electronics, and information technologies. The university provides scholarships and internships for students, including collaborations with leading companies in the field.
- **University of Chemical Technology and Metallurgy** - Faculty of Chemistry and Pharmacy: Offers undergraduate programs in chemistry, chemical engineering, and pharmacy. The faculty provides scholarships and internships for students, including research opportunities in collaboration with industry partners.



Bulgaria

Undergraduate Programs:

- **University of Architecture, Civil Engineering and Geodesy** - Faculty of Geodesy: Offers undergraduate programs in geodesy, geoinformatics, and geology. The university provides scholarships and internships for students, including collaborations with surveying and mapping agencies.
- **Plovdiv University "Paisii Hilendarski"** - Faculty of Mathematics and Informatics: Offers undergraduate programs in mathematics, computer science, and informatics. The faculty provides scholarships and internships for students, including research opportunities in collaboration with academic and industry partners.
- **American University in Bulgaria - Department of Computer Science**: Offers undergraduate programs in computer science. The university provides scholarships and internship opportunities for students, including collaborations with international organizations and tech companies.
- **Technical University of Varna - Faculty of Electronics**: Offers undergraduate programs in electronics, telecommunications, and computer science. The university provides scholarships and internships for students, including collaborations with industry partners.



Bulgaria

When it comes to **scholarships** and **internships**, it is recommended to visit the respective university websites, as they often have dedicated pages or offices that provide information on available opportunities. Additionally, students can explore government-funded programs, industry-specific scholarships, and internships offered by local companies and organizations in Bulgaria:

Scholarships & Internships:

- **The Women in Science Foundation (WiSF) Scholarships:** This foundation offers scholarships to women pursuing STEM careers in Bulgaria. The scholarships aim to support women in their academic and professional development in fields such as science, technology, engineering, and mathematics.
- **The Bulgarian Women in Technology (BWIT) Scholarships:** BWiT offers scholarships for women studying or working in the field of technology in Bulgaria. The scholarships aim to encourage and support women's participation in the technology industry by providing financial assistance for education and professional development.



Bulgaria

Scholarships & Internships:

- The Bulgarian Association of Women in STEM (BAWiSTEM) Scholarships: BAWiSTEM offers scholarships to women pursuing STEM careers in Bulgaria. The scholarships aim to promote gender equality in STEM fields and provide financial support for women's education and research in science, technology, engineering, and mathematics.
- The Bulgarian National Science Fund (BNSF) Grants for Women in STEM: BNSF provides grants specifically for women researchers and scientists in Bulgaria. The grants support women's research projects in various STEM disciplines and aim to increase the representation of women in scientific research.
- The Bulgarian-American Fulbright Commission Scholarships for Women in STEM: The Fulbright Commission in Bulgaria offers scholarships for women pursuing STEM careers. These scholarships provide opportunities for study, research, and professional development in the United States and aim to promote gender equality in STEM fields.



It's important to regularly check the respective websites for updated information on eligibility criteria, application deadlines, and other requirements for these scholarships and grants.



Romania

Romania offers a range of STEM-related undergraduate programs, scholarships, and internships for students. Here is some information on these opportunities

Undergraduate Programs:

- **Technical University of Cluj-Napoca:** Offers undergraduate programs in Computer Science, Electrical Engineering, Mechanical Engineering, and Civil Engineering. Website: <https://www.utcluj.ro/en/>
- **University Politehnica of Bucharest:** Offers undergraduate programs in Aerospace Engineering, Biomedical Engineering, Computer Science, Electrical Engineering, and more. Website: <https://www.upb.ro/en/>
- **University of Bucharest:** Offers undergraduate programs in Mathematics, Physics, Chemistry, Biology, and Computer Science. Website: <https://www.unibuc.ro/en/>



Romania

Romania offers a range of STEM-related undergraduate programs, scholarships, and internships for students. Here is some information on these opportunities

Scholarships:

- **Romanian Government Scholarships:** The Romanian Ministry of Foreign Affairs offers scholarships to foreign citizens through the Ministry of Education and Research. These scholarships cover tuition fees, accommodation, and a monthly allowance. Website: <http://www.mae.ro/en/node/10251>
- **Erasmus+ Scholarships:** The Erasmus+ program provides scholarships to students who wish to study abroad in European countries. Romanian universities participate in this program, offering opportunities for international students. Website: https://ec.europa.eu/programmes/erasmus-plus/node_en




Romania


Romania offers a range of STEM-related undergraduate programs, scholarships, and internships for students. Here is some information on these opportunities

Internships:

- **Microsoft Internship Program:** Microsoft's offices in Romania offer internships for students in Computer Science, Software Engineering, and related fields. The program provides hands-on experience and the opportunity to work with industry professionals. Website: <https://careers.microsoft.com/students/internships>
- **IBM Internship Program:** IBM Romania provides internships in various areas, including Software Engineering, Data Science, Cybersecurity, and Artificial Intelligence. These internships offer valuable work experience and mentorship from industry experts. Website: <https://www.ibm.com/ro-en/employment/internship/>



It is important to note that this is just a sample of the opportunities available in Romania. It is recommended to visit the official websites of universities and organizations for up-to-date information on programs, scholarships, and internships. Additionally, students can explore other sources such as professional networks, online platforms, and local organizations for further opportunities.



ACTIVITIES FOR STUDENTS

STEM CLUB VIDEOS

Robotics CLUB <https://youtu.be/rE9wWSIBfM4>

Girls interviews about First LEGO® League competitions

1. https://www.youtube.com/watch?v=nzDmwUDo_oc
2. <https://www.youtube.com/watch?v=KcPCZO94mys>



SECTION 7: ONLINE RESOURCES & TOOLS

01

STEM Websites, Blogs,
Podcasts

02

Virtual Laboratories

03

Online Courses and MOOCs

04

STEM Apps and
Games

05

STEM Competitions: Details about local, national, and international STEM competitions to inspire students to showcase their talents and creativity

7.1 STEM Websites, Blogs, Podcasts

A curated list of reputable online platforms offering interactive lessons, tutorials, and educational videos.

- ➔ **Khan Academy** (www.khanacademy.org): A popular platform offering free online courses and lessons in various STEM subjects, including math, science, computer programming, and more.
- ➔ **Code.org** (www.code.org): A website dedicated to teaching students how to code, with interactive tutorials, games, and resources for all ages and skill levels.
- ➔ **edX** (www.edx.org): A massive open online course provider offering a wide range of STEM courses from top universities worldwide. Some courses are free, while others require a fee for a verified certificate.
- ➔ **Science Buddies** (www.sciencebuddies.org): A comprehensive resource for science fair project ideas, guides, and resources for students of all ages.
- ➔ **NASA STEM Engagement** (www.nasa.gov/stem): NASA's official website for STEM engagement, offering educational resources, games, videos, and activities related to space exploration and scientific discovery.

7.1 STEM Websites, Blogs, Podcasts



National Geographic Kids (kids.nationalgeographic.com): A website that provides educational content on various STEM topics, including animals, geography, and the environment, through articles, quizzes, and interactive games.



MIT OpenCourseWare (www.ocw.mit.edu): Massachusetts Institute of Technology's initiative to make their course materials, including lecture notes, assignments, and exams, freely available online for self-study in various STEM disciplines.



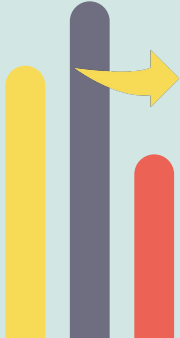
DiscoverE (www.discovere.org): A website dedicated to promoting engineering and technology education, offering resources, activities, and events for students, parents, and educators.



The STEM Laboratory (www.thestemlaboratory.com): A blog providing hands-on STEM activities and lessons for elementary and middle school students, with a focus on hands-on experiments and projects.



TeachEngineering (www.teachengineering.org): A digital library of engineering curricula and activities for K-12 educators, offering lesson plans, videos, and hands-on projects for teaching various engineering concepts.



7.1 STEM Websites, Blogs, Podcasts



Scratch (www.scratch.mit.edu): A visual programming language designed for kids, allowing them to create interactive stories, games, and animations.



Blockly (www.developers.google.com/blockly): A web-based visual programming editor that introduces coding concepts through block-based coding.



Tinkercad (www.tinkercad.com): An online platform for designing and 3D modeling, offering tools for STEM-related projects.



Wolfram Alpha (www.wolframalpha.com): A computational knowledge engine that provides answers and solutions to a wide range of STEM-related questions.



PhET Interactive Simulations (www.phet.colorado.edu): Offers free interactive simulations for science and math subjects, allowing students to explore concepts through virtual experiments.



STEM-Related Podcasts, YouTube Channels, and Blogs:



TED-Ed (www.ed.ted.com): Provides educational TED Talks on various STEM topics, suitable for students.



SciShow (www.youtube.com/user/scishow): A YouTube channel exploring scientific concepts in an entertaining and easy-to-understand manner.



Crash Course (www.youtube.com/user/crashcourse): Offers engaging video courses on different subjects, including science and computer science.



National Geographic Kids (www.kids.nationalgeographic.com/explore/science): A website featuring articles, videos, and interactive games that cover a wide range of scientific topics for kids.



Code.org Blog (www.blog.code.org): A blog that shares news, resources, and stories related to coding education and STEM initiatives.



NASA's STEM Engagement Blog (www.blogs.nasa.gov/education): Provides updates, resources, and educational content related to NASA's STEM initiatives.



7.1 Virtual laboratories

Accessible simulations and virtual labs for conducting experiments and exploring scientific concepts.



Benefits of Virtual Laboratories

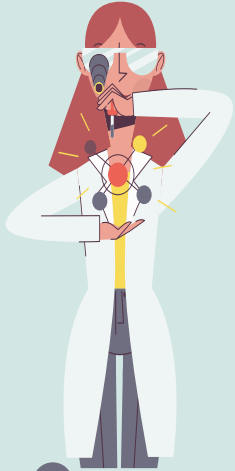
- Cost-effectiveness
- Accessibility and flexibility
- Safety
- Enhanced visualization
- Increased experimentation opportunities



Examples of Virtual Laboratories

- Physics simulations
- Chemistry simulations
- Biology simulations

Benefits of Virtual Laboratories

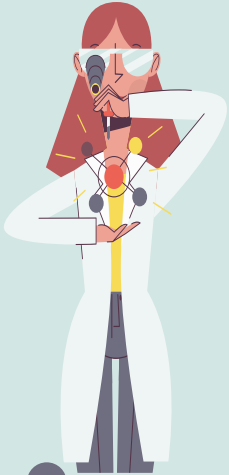


Cost-effectiveness: Traditional laboratories require substantial investments in equipment, materials, and maintenance. Virtual laboratories eliminate these costs, allowing students to access a wide range of experiments and simulations at a fraction of the price. This cost-effectiveness enables educational institutions to offer a more comprehensive and diverse science curriculum.

Accessibility and flexibility: Virtual laboratories are accessible to students from anywhere, at any time. This flexibility allows for self-paced learning, accommodating students with different schedules and learning preferences. Additionally, virtual laboratories can be accessed on various devices, including computers, tablets, and smartphones, making them convenient for students with limited access to physical facilities.



Benefits of Virtual Laboratories



Safety: Conducting experiments in a virtual environment eliminates the risks associated with handling hazardous materials or operating complex equipment. Students can explore experiments that may be impractical or unsafe in a traditional laboratory setting. This ensures their safety while providing an opportunity to learn and understand scientific concepts effectively.

Enhanced visualization: Virtual laboratories often offer advanced visualization techniques, such as 3D models and real-time simulations. These features allow students to visualize complex scientific phenomena, making abstract concepts more tangible and easier to comprehend. By providing a visual representation, virtual laboratories enhance students' understanding and retention of scientific concepts.

Increased experimentation opportunities: Virtual laboratories offer a vast array of experiments and simulations, allowing students to explore a wide range of scientific concepts. Unlike traditional laboratories, where resources and time constraints may limit the number of experiments students can conduct, virtual laboratories provide unlimited opportunities to practice and refine their skills. This increased experimentation promotes a deeper understanding of scientific principles and fosters curiosity and critical thinking.

Examples of Virtual Laboratories



Physics simulations: Virtual laboratories can simulate various physics experiments, such as projectile motion, pendulum oscillations, and electrical circuits. These simulations allow students to manipulate variables, measure data, and observe the outcomes in real-time, providing a hands-on experience without physical resources.



Chemistry simulations: Virtual laboratories offer simulations for chemical reactions, molecular structures, and spectroscopy. Students can mix different substances, measure reaction rates, and observe the changes in molecular structures, facilitating a better understanding of chemical principles.



Biology simulations: Virtual laboratories provide simulations for studying biological processes, such as cell division, genetics, and ecological systems. Students can explore the intricacies of living organisms, observe microscopic structures, and simulate the effects of environmental factors on populations, promoting a deeper understanding of biological concepts.



CONCLUSIONS

Virtual laboratories provide students with a safe, cost-effective, and flexible platform to conduct experiments and explore scientific concepts. Through advanced visualization techniques and increased experimentation opportunities, these simulations enhance students' understanding and engagement with scientific principles.

By incorporating virtual laboratories into the curriculum, educational institutions can offer a comprehensive and immersive learning experience that prepares students for future scientific endeavors.



Here are some Open Educational Resources (OERs) that offer virtual laboratories in physics, chemistry, and biology:

PhET Interactive Simulations (Physics, Chemistry, Biology)

Website: <https://phet.colorado.edu/>

PhET provides free online interactive simulations for various topics in physics, chemistry, biology, and more. These simulations allow students to perform virtual experiments and explore concepts in an interactive manner.

Virtual Chemistry Laboratory (Chemistry)

Website: <http://www.virtual-chemistry.net/>

This virtual laboratory offers a range of experiments covering topics such as stoichiometry, gas laws, acid-base reactions, and more. It provides a realistic and interactive experience for students to practice chemistry experiments online.

Virtual Biology Lab (Biology)

Website: <http://www.virtualbiologylab.org/>

Virtual Biology Lab offers a collection of virtual experiments and simulations covering topics like cell biology, genetics, ecology, and physiology. It allows students to explore biological concepts and perform virtual lab activities.

Virtual Physics Lab (Physics)

Website: <http://www.virtualphysicslab.org/>

Virtual Physics Lab offers a variety of virtual experiments in physics, including mechanics, electricity, magnetism, and optics. Students can manipulate virtual equipment and observe the outcomes of their experiments.

LabXchange (Biology)

Website: <https://www.labxchange.org/>

LabXchange is an online platform that provides interactive virtual labs, simulations, and other educational resources in biology. It offers a wide range of topics and allows students to access virtual experiments and lab activities.

ChemCollective Virtual Labs (Chemistry)

Website: <https://chemcollective.org/vlabs>


ChemCollective Virtual Labs provides a collection of virtual chemistry lab experiments. It covers topics such as acid-base reactions, titrations, gas laws, and more. Students can perform experiments and analyze the results online.




Please note that while these resources offer virtual laboratories, they may have specific system requirements or may require registration in some cases.

7.3 Online courses and MOOCs


Recommendations for free or affordable online courses from renowned institutions, enabling students to expand their knowledge and skills.




Coursera: Coursera offers a wide range of online courses from top universities and institutions around the world. They offer both free and paid courses, with options to earn certificates upon completion. Some popular courses include "Learning How to Learn" from the University of California, San Diego and "Introduction to Computer Science" from Harvard University.



edX: edX is another platform that provides access to high-quality online courses from prestigious universities like MIT, Harvard, and Berkeley. They offer both free and paid courses, and certificate options are available. Popular courses include "Introduction to Artificial Intelligence" from Columbia University and "Introduction to Python Programming" from the Georgia Institute of Technology.



Khan Academy: Khan Academy is a non-profit organization that offers free online courses in various subjects including math, science, humanities, and more. Their courses are self-paced and cover a wide range of grade levels, making it suitable for students of all ages. Khan Academy is particularly known for its math tutorials and practice exercises.



Udemy: Udemy is an online learning marketplace that offers a vast selection of courses on various topics. While some courses are free, most are paid, but they often have significant discounts. Udemy courses are created by industry experts and cover areas like business, coding, photography, and personal development.

7.3 Online courses and MOOCs

Recommendations for free or affordable online courses from renowned institutions, enabling students to expand their knowledge and skills.

- ➔ **MIT OpenCourseWare:** MIT OpenCourseWare provides free access to course materials from actual MIT courses. While you won't receive official certification, it's an excellent resource for self-study and expanding your knowledge in subjects like engineering, computer science, and humanities.
- ➔ **Codecademy:** Codecademy is a platform focused on teaching coding and programming languages. They offer both free and paid courses, with interactive lessons and hands-on coding exercises. Codecademy is an excellent choice for students interested in learning web development, data science, or other programming skills.
- ➔ **FutureLearn:** FutureLearn is a platform that offers courses from universities and institutions worldwide. They provide both free and paid courses, with options for certificates. FutureLearn covers a wide range of subjects, including business, healthcare, and creative arts.
- ➔ **Google Digital Garage:** Google Digital Garage provides free courses on digital marketing, analytics, coding, and more. The courses are designed to enhance digital skills and provide certifications from Google.



These platforms offer a variety of courses at different price points, ensuring that students can find something suitable for their needs and budget. It's essential to check the course syllabus, reviews, and ratings before enrolling to ensure the course aligns with your goals and expectations.

7.4 STEM Apps and Games

Engaging mobile applications and educational games that facilitate learning and problem-solving in a fun and interactive way.

- ➔ **"Khan Academy"** - This app provides a wide range of educational videos and interactive exercises covering various subjects like math, science, computer programming, and more.
- ➔ **"Scratch"** - An interactive coding platform that allows students to create their own games, animations, and interactive stories. It helps develop computational thinking and problem-solving skills.
- ➔ **"DragonBox"** - A series of math games that make learning algebra and geometry fun and engaging for students. It uses a puzzle-based approach to help build a strong foundation in math concepts.
- ➔ **"Code.org"** - This app offers a series of coding tutorials and challenges suitable for students of different age groups. It introduces programming concepts and encourages logical thinking and problem-solving skills.
- ➔ **"BrainPOP"** - An app that provides animated videos on various STEM topics like science, technology, engineering, and math. It also includes quizzes and games to reinforce learning.

7.4 STEM Apps and Games

Engaging mobile applications and educational games that facilitate learning and problem-solving in a fun and interactive way.

- ➔ **"Tynker"** - This app teaches coding concepts through interactive games and challenges. It allows students to create their own games and animations using block-based programming.
- ➔ **"GeoGebra"** - A powerful math app that combines geometry, algebra, and calculus. It provides tools for graphing, creating geometric constructions, solving equations, and more.
- ➔ **"NASA Visualization Explorer"** - This app offers stunning visualizations and interactive stories about NASA missions, Earth science, and space exploration. It helps students explore and understand complex scientific concepts.
- ➔ **"Duolingo"** - While not strictly a STEM app, Duolingo is a popular language learning app that offers interactive lessons and games to help students learn languages like Spanish, French, German, and more.
- ➔ **"Quizlet"** - An app that allows students to create and study flashcards on various subjects. It includes games and quizzes to reinforce learning and memory retention.
- ➔ **Phet (<https://phet.colorado.edu/>)**. This free interactive website is filled with fun and enjoyable simulations that pertain to the four core subjects of STEM education.

7.4 STEM Apps and Games

Engaging mobile applications and educational games that facilitate learning and problem-solving in a fun and interactive way.

➔ **Gizmos (<https://gizmos.explorellearning.com/>)**. It is a world's largest library of math and science virtual labs and simulations. Gizmos are interactive math and science virtual labs and simulations for grades 3-12.

➔ **Planetarium (<https://stellarium-web.org/>)** Stellarium is a free open-source planetarium that can be used in Geography and Physics lessons. It shows a realistic sky in 3D, just like what you see with the naked eye, binoculars or a telescope. This website lets students explore the heavenly bodies in a browser. It can be added as an extension for Google Chrome users. There is a mobile app that can be downloaded from Google Play or App store.

➔ **Interactive Periodic table (<https://ptable.com/>)**. This interactive periodic table showing names, electrons, and oxidation states. It visualizes trends, 3D orbitals, isotopes, and mix compounds. There is a translation in 73 languages.



These STEM apps and games provide an engaging and interactive learning experience, making education fun and accessible to students.

7.5 STEM Competitions

Details about local, national, and international STEM competitions to inspire students to showcase their talents and creativity.



Europe is a hub for various STEM competitions that provide students with opportunities to showcase their talents and creativity.

Here are some details about local, national, and international STEM competitions in Europe:



7.4 STEM Competitions

European Union Contest for Young Scientists (EUCYS)

- This is an annual competition organized by the European Commission for students aged 14-20.
- Participants present their scientific research projects to a jury of experts from different scientific fields.
- Winners receive cash prizes and recognition, and the top projects have the chance to participate in international science fairs.



FIRST LEGO League (FLL) Europe

- FLL is a global robotics competition for students aged 9-16.
- Teams design, build, and program LEGO robots to complete specific missions on a themed playing field.
- The European FLL tournament brings together teams from different European countries to compete for a spot in the international event.

7.4 STEM Competitions

European BEST Engineering Competition (EBEC)

- EBEC is a multidisciplinary engineering competition organized by BEST (Board of European Students of Technology).
- Students work in teams to solve real-life engineering challenges, such as designing prototypes or optimizing processes.
- EBEC consists of local, national, and regional rounds, leading to the final round where the winners are crowned as the best engineering students in Europe.



Google Science Fair

- This is a global online competition for students aged 13-18, but European students can participate and compete for regional and global prizes.
- Participants develop a scientific project and present it through a written report, images, and videos.
- The competition encourages students to tackle real-world problems using STEM knowledge and creativity.

7.4 STEM Competitions

European Space Agency (ESA) Competitions

- ESA organizes various competitions throughout the year, including the CanSat competition, the Zero Robotics competition, and the Moon Camp Challenge.
- These competitions focus on space-related projects and challenges, allowing students to explore different aspects of space science and technology.



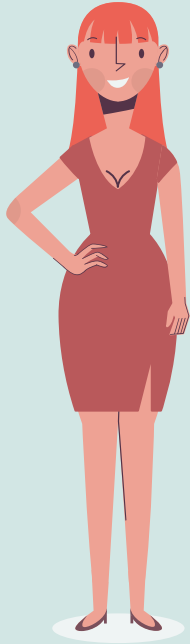
European Space Agency

European Robotics League (ERL)

- ERL organizes robotics competitions in different categories, such as emergency response, industrial inspection, and service robots.
- Teams compete in local and regional tournaments, and the best teams from each category advance to the European finals.
- ERL provides a platform for students to develop their robotics skills and compete at an international level.



7.4 STEM Competitions



European Girls' Mathematical Olympiad (EGMO)

- EGMO is an annual competition exclusively for female students aged 13-20.
- Participants solve challenging mathematical problems in a competitive environment, representing their countries.
- The competition aims to encourage and support girls' participation in mathematics and STEM fields.



These are just a few examples of the diverse STEM competitions available in Europe. Students interested in participating should visit the respective competition websites for more information, eligibility criteria, and application details. Participating in these competitions can not only enhance students' STEM skills but also provide them with valuable experiences and networking opportunities.

THANK YOU FOR YOUR ATTENTION



SHE CHOOSES STEM
FOR THE FUTURE



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