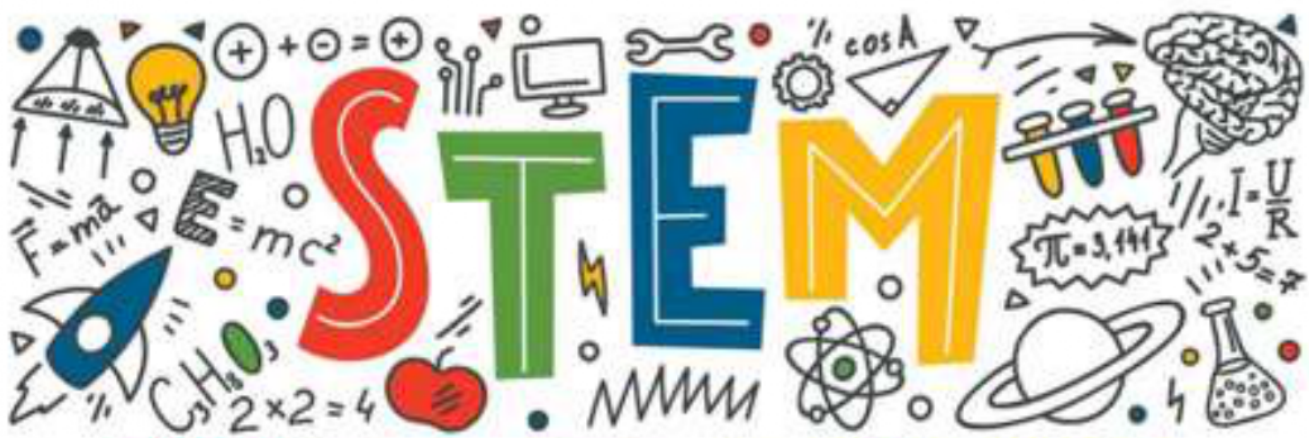
Government of Pakistan
Ministry of Science and Technology

GRADE 10

STEM PROJECTS

Aligned with National Curriculum of Mathematics, Physics, Chemistry, Biology and Computer Science

TEACHING GUIDE
LESSON PLANS
STEP-BY-STEP INSTRUCTIONS
ACTIVITY SHEETS



Science, Technology, Engineering, and Mathematics

Launching of STEM in Pakistan
A project of Pakistan Science Foundation
Ministry of Science and Technology

Pakistan Science Foundation
1-Constitution Avenue, G-5/2, Islamabad
www.psf.gov.pk

Children and Youth Science Center (CYSC)
Chinese Association of Science and Technology (CAST)

ACKNOWLEDGEMENT

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Pakistan Science Foundation (PSF), established in 1973 through an Act of Parliament, is the apex body working under the umbrella of the Ministry of Science and Technology for the promotion and funding of scientific and technological research and science popularization in the country. "Launching of STEM in Pakistan, Phase-I" is a newly approved public sector development project (PSDP).

The major objectives of the STEM project are as follows;

1. *To officially launch STEM, the modern tool for the promotion of Science, Technology, Engineering, and Mathematics Education in Pakistan (in 50 HSS/Cadet Colleges in 1st phase).*
2. *To coordinate the provision of specialized national and international capacity-building programs on STEM education for science teachers and pedagogues.*
3. *To coordinate development, introduction, and adoption of modern pedagogical tools & and interventions for STEM including STEM framework/global best practices like IBSE/ LAMAP.*
4. *To equip our youth with meaningful learning through hands-on experiences and improve their cognitive abilities.*
5. *To develop entrepreneurship skills amongst students through STEM education to make them job givers instead of job seekers.*

This project's STEM lesson plans were created using a variety of tools and techniques, such as the participation of top-notch scientists and researchers across the country, the hiring of a reputable company called TeleTaleem (www.teletaleem.com), and aegis of the Children and Youth Science Centre of the Chinese Association of Science and Technology (CYSC-CAST).

ACKNOWLEDGEMENT

The STEM team at Pakistan Science Foundation's STEM Academy examined, graded, evaluated, assessed, and revised the lesson plans that were developed by various sources. The PSF was able to produce a top-notch reference book for Grade 9 thanks to the outstanding support of the Chinese equivalent organization (CYSC-CAST).

These experiments were meticulously designed in line with Pakistan's National Curriculum in a variety of scientific subjects. The STEM Teaching Guide for various levels Grade 9, 10, 11, and 12, and teacher training manuals for all the grades are also being published.

The STEM module book is available on the STEM-PSF website https://stem.psf.gov.pk/Default.aspx

STEM modules are also available on the STEM LMS. Meanwhile, the fabrication of STEM kits, that have been designed through modules on engineering, materials, nanotechnology, energy, medicine, microbiology, industry, scientific instruments, fuel cells, renewable energy, robotics, artificial intelligence, energy storage, electronics, gravity, astronomy, water, and food.

This project will provide opportunities for technology, innovation, and entrepreneurship as well as serve as a source of new knowledge production in a number of areas beyond national boundaries.

Dr. Ahsan Feroze
Project Director (STEM)

PREFACE

Welcome to this collection of STEM Projects. In a world driven by science, technology, engineering, and mathematics, curiosity has the power to shape the future. This book is a culmination of that curiosity—an assemblage of hands-on projects designed to inspire, educate, and ignite a passion for the wonders of the STEM disciplines.

The journey through STEM is a dynamic one, marked by discovery, innovation, and the endless pursuit of understanding the intricacies of our universe. As you turn these pages, you'll find a diverse array of projects that encompass various fields, each carefully crafted to encourage you to question, experiment, and engage with the world around you.

From constructing model bridges that test the principles of engineering, to coding simulations that unravel complex scientific phenomena, to delving into the realms of mathematics that underpin our technological advancements—this collection offers a plethora of opportunities to delve into the heart of STEM. Whether you're a student taking your first steps into these domains or an experienced enthusiast or a teacher seeking new challenges, there's something here for everyone.

These projects not only serve as outlets for creativity and critical thinking, but also as gateways to understanding how the principles of STEM shape our daily lives. They showcase the practical applications of theory, enabling you to bridge the gap between abstract concepts and tangible outcomes. Each project is a chance to observe the interplay between theory and reality, while also fostering the invaluable skills of problem-solving, teamwork, and perseverance.

This book wouldn't be possible without the dedication and enthusiasm of countless individuals who have a deep-rooted passion for STEM. It's a testament to their unwavering commitment to sharing knowledge and inspiring the next generation of thinkers, creators, and innovators.

PREFACE

PREFACE

So, whether you're embarking on these projects independently, as part of a classroom experience, or even as a family endeavor, remember that exploration knows no bounds. The world of STEM is boundless and ever-evolving, and each project you undertake is a step toward unraveling its mysteries.

As you embark on this adventure of exploration and discovery, we hope that these projects will not only provide you with the tools to create and learn, but also with a lasting sense of awe for the beauty and complexity of the STEM world. May your journey through these pages be just the beginning of a lifelong pursuit of knowledge and a deep-seated appreciation for the marvels that STEM has to offer.

Happy exploring!

BIOLOGY

01 **BREATHING MOVEMENT**
Explore how the parts of respiratory system move to allow ventilation of lungs.

25 **WORKING OF BICEPS AND TRICEPS TO MOVE THE ARM**
How to aid in recovery of strained bicep by engineering a biomedical device?

41 **SEED GERMINATION**
Identify the conditions needed for seed germination and demonstrate by planning an investigation on how they germination?

61 **DNA PURIFICATION AND EXTRACTION**
How can you extract DNA from strawberry using your own DNA kit?

78 **YEAST RESPIRATION**
Yeast cells respire too, but not like me and you.

97 **GASEOUS EXCHANGE DURING VENTILATION OF LUNGS**
Investigate how inhaling air high in carbon dioxide concentration can affect humans.

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CHEMISTRY

118 **GUMMY OZONE HOLE**
Assume you are teaching your younger sibling about how Ozone layer is depleting but they can't seem to grasp the concept no matter how simple words you use. Can you hold a demonstration to make it easier for them to understand?

130 **INVISIBLE INKS**
Your mission is to write a secret message to your fellow agent, instructing them on their next mission. The message must be written in invisible ink and only become visible when treated with a specific solution. You have to ensure that the enemy does not intercept the message and discover its contents.

146 **DIY WATER FILTER**
The water in your area is badly polluted and making children ill. Can you make a water purifier prototype for your community to filter impurities from drinking water using commonly available materials?

163 **MAGNETIC SEPARATOR**
Can you build a Magnetic Separator to separate out your magnetic and non-magnetic stuff?

180 **BUILD YOUR OWN DISTILLATORY**
You work in industry and you have a water/alcohol mixture that needs to be separated. Can you build a fractional distillation device?

200 **MAKE A VIDEO ABOUT THE USE OF HYDROCARBONS IN OUR DAILY LIVES**
Hydrocarbons are an important component of our daily life. Carry out an extensive research on how hydrocarbons are used in different industries and what is their future.

PHYSICS

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211 **ELECTRICITY GENERATION**
The people of the small Village of Rupal in Pakistan's remote mountains have always struggled to access electricity. For years they have relied on oil lamps to light their homes but these are expensive and not always reliable. Build a prototype of a small-scale mechanical renewable energy generator to power their homes.

226 **DIY WAVE MACHINE**
MAKE YOUR OWN WAVE MACHINE. Can you design and construct a wave machine to demonstrate the properties and behavior of wave motion?

240 **DIY CAPACITOR**
Can you building your own DIY capacitors, to help provide a cost-effective solution for these individuals to power their devices?

256 **TOUCH SENSOR**
How can we as Electronic Engineers design a touch sensor circuit that can be used to operate a touch lamp (where a lamp turns on when you touch its base)?

272 **HOMEMADE PROJECTOR**
How can we as inventors design and make a homemade projector following the principles of refraction of light and Image formation of lenses?

288 **MAKING A DIY TELESCOPE**
How can we as physicists design a low-cost telescope that can help us understand how lenses and mirrors work?

MATHEMATICS

301 **SELFIES WITH PARABOLAS**
How can we as mathematical modelers find and plot graphs of real-life parabolas?

314 **MODELLING THE CIRCLE**
How can we design a model to prove that if the angles subtended by two chords of a circle, at the centre, are equal, then then the chords will be equal?

331 **WHAT'S THE SET?**
How can we use simple items to explain the properties of sets?

345 **MANAGE YOUR DATA!**
How can we, as statisticians, evaluate the usefulness of histograms in drawing statistically valid conclusions?

359 **QUADRATIC GRAPHS**
How can we, as mathematicians, use GeoGebra to solve, visualize and graph quadratic equations?

371 **TRIGONOMETRY VIA SMARTPHONE**
How can we as engineers apply the mathematical principles of trigonometry to create a triangle with a given side length and one angle?

COMPUTER SCIENCE

385 **UNDERSTANDING ALGORITHMS AND IMPLEMENTATION IN PYTHON**
How can you apply problem-solving strategies to develop algorithms that effectively resolve programming problems?

401 **CAESAR CIPHER CODING CHALLENGE**
Learn the basics of encryption and decryption using the Caesar Cipher algorithm through hands-on programming practice in Python.

420 **CONTROLLING MULTIPLE DEVICES USING IOT**
How can you as Computer Scientists operate and control electronic components wirelessly using IoT technology?

445 **FLOWCHART AND ALGORITHM WITH MS VISIO**
How can we as computer scientists use multiple ways to solve one problem?

463 **ARE YOU ELIGIBLE TO REGISTER WITH OUR BANK?**
As a software developer, you are tasked with developing a program that tells the eligibility of a person to register with the bank.

482 **DESIGNING AND PROGRAMMING THE APPLE CATCHER GAME**
As a game developer, you have been tasked with designing a simple game that anyone can play no matter their age.

PROJECTS CONTRIBUTED BY CYSC-CAST

(Children and Youth Science Center, China Association of Science and Technology)

506 **BUILDING A STRUCTURAL MODEL OF DNA**
The structure and interactions of the basic building blocks of DNA.

523 **LEARNING ELECTROCHEMSITRY BY BUILDING ELECTRIC VEHICLES**
Use a typical e-bike battery as an example to describe the components, construction, and function of a lead battery.

537 **TURNING POLLUTED WATER INTO DRINKING WATER**
How does a "magic machine for water purification" on the market turn polluted water into drinking water? Let's decipher the "magic machine for water purification" and design a water purification device by yourself.

551 **AUTOMATIC DRIVING TECHNOLOGY**
Automatic driving vehicles need to have accurate and fast judgments on driving routes, road conditions and speeds to ensure safety during driving. How are these functions implemented?

561 **DETERMINATION OF GLUCOSE CONCENTRATION - MAKING ULTRAVIOLET VISIBLE SPECTROPHOTOMETER**
Explore the working principle of the ultraviolet visible spectrophotometer, and make a ultraviolet visible spectrophotometer that can be used to measure the concentration of glucose

PROJECTS ON EMERGING TECHNOLOGIES

574 **WATER LEVEL INDICATOR WITH ARDUINO**
Can You Make the Waves of Knowledge Rise? Learn how to build a water level indicator using an Arduino board, the components involved and the code required to make the project work.

589 **SMART BARRIER SYSTEM: EXPLORING SENSOR TECHNOLOGY WITH ARDUINO**
How can we revolutionize barrier systems with smart technology and Arduino by creating a system that can detect obstacles and act accordingly?

612 **HYDRO HUSTLERS: ENGINEERING EFFICIENT WATER TURBINES**
Channeling Water Power for a Sustainable Future!

630 **CATCH THE CAT: DEVELOP AN INTERACTIVE MOBILE GAME WITH MIT APP INVENTOR**
Can you create an app "Catch the Cat"? Learn to design and develop an interactive game using the MIT App Inventor platform.

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