



# **CENTRE FOR STEM & SPACE SCIENCE**

Nurturing Technocrats of Future

## **Proposal for STEM & Space Science Education in Schools**

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## About Us

Education Career Foundation (ECF) has been established in 2016 under the aegis of Education Career Foundation Charitable Trust under the Act 1860 and 1950 of charity commissioner of India with the realization that social transformation can occur through the spread of high quality education. ECF has received 12AAG from Income Tax Department of India and designated as ISO 9001:2015 Certified Charitable Trust.

The horizon of Educational Career Foundation (ECF) have been widening since establishment. All the programs are designed to make students more practical oriented and thereby make them more confident in facing real life challenges. With the well-equipped infrastructure, facilities of information and communication technology and with a team of dedicated staff ECF is all geared to take up all challenges in era of globalization. The selfless efforts put by the devoted teachers and staff enabled ECF to carve its own niche in the field of education.

In today's world on every step there is huge competition at every stage of life hence ECF prepares individual not only for their future profession but also gives lifelong learning.

We are offering new and contemporary elective courses, reviewing courses offerings, developing new project material, and modernizing IT infrastructure. We provide Management Programs, Certification and Diploma Courses. Other certified training courses in both online and offline mode for the professional growth of an individual. We have developed smart phone-based applications, Blog site for interactivity, online library, social media integration, etc. ECF also provides free counselling and career guidance for today's youth.

## Feathers of Education Career Foundation (ECF)

- Group of Junior and Senior colleges across Pune city (Arts, commerce & Science)
- Institute of skills and Entrepreneurship Development
- Successful Integration of ICT in Education
- Career Guidance
- Education Consultants
- Achievement: **Education Icon Awards 2020**

# Centre for STEM and Space Science

Nurturing Technocrats of Future

## Need of New Age Curriculum and Activities:

We are in the era of advanced technology and its applications are part of daily lives. Rapid advancements in science and technology force us to be updated at all levels. Automation is the reality and job world is constantly changing. The requirement for highly skilled professionals with strong domain knowledge and technical skills is increasing in all the fast-growing industries. Technological workforce is in demand now and will be forever. Government and private organisations are working on specialised skill development for employment and industrial development. But the goals can be better achieved if we work on installing the characteristics and personal skills that are required for creation of skilled workforce of Scientists, Engineers, Researchers, Technocrats and Leaders. Instilling the traits in early educational period will be most beneficial as students can identify and learn new skills, get exposure to various tasks and problems early so as to learn problem solving, critical thinking, analytical thinking, creativity, innovation, project management and much more.

So, with the aim to provide facilities and infrastructure ECF has initiated the Centre for STEM and Space Science where every student can learn, participate, acquire new skills, make projects, solve problems of real life, create something new along with his/her regular curriculum. This centre will definitely add value to educational development of students.

## What is STEM education?

STEM consists of Science, Technology, Engineering and Mathematics. STEM education refers to studying these areas with a hybrid approach involving theory as well as experiment. It is a concept introduced in the United States in 2001 and has become one of the most effective methods of education. The main aims are to generate critical thinking of students, nurture their curiosity, enhance their leadership qualities and provide the right skills that are relevant in the present and future. STEM education relies on concept based learning and hands-on approach to education, where students will learn more effectively through activities and projects designed to cater to the aforementioned aims.

## Skills developed through STEM Education



## **What is Space Science?**

Everyone is always fascinated about 'How does the universe work?', 'How many stars, planets and galaxies are there?', and 'what are black holes?' And the one that inspires the most 'Is there life beyond Earth?' Astronomy is a science that seeks to answer such questions through observation and scientific methods. Space science is an interdisciplinary subject that is naturally linked with technology and instrumentation that can be of great help in honing the practical and observational skills of students

## **STEM and Space Science Learning as a Co-Curricular Activity**

Along with regular school curriculum, students are expected to undergo co-curricular and extra-curricular activities. The aim of such activities is to tap into the curiosity and skillsets of individual students and help in shaping them. STEM and Space Science education makes use of concepts from science and maths, and exposes students to the current technologies in use around them at a young age. Activities such as astronomy lectures by experts, telescope handling, stargazing, lab experiments and projects are all designed to help students develop their scientific temperament along with fostering their core concepts.

Beyond its simple fascinating nature, astronomy is a science that offers something new to learners at every level, making it one of the best co-curricular activities for schools.

## **Importance of STEM & Space Science**

Space science consists of astronomy, astrophysics, electronics, rocket science, earth science and many more so it can be considered as one of the most effective methods to apply STEM education. Space science helps student build conceptual understanding about all the fields and helps to develop curiosity through applications. Space science provides opportunities for the student to get hands-on experience on the advanced instruments and introduces them with experimental techniques which help student develop critical thinking, decision making and problem solving. Space science education contributes significantly in the creation of technologically educated manpower pool.

With the current advancement in this field, there will be a continuous demand of professionals. In India, astronomy and space science courses are taught at the post graduate level. These courses are generally specialized. There is a need of a curriculum that fills the gap between the current school - college curriculum and skills required for these specialized courses.

## **Further Education and Career**

STEM education focuses on acquiring technical skills and knowledge that is useful in the present and will continue to be relevant. STEM curriculum is no longer just a better way of learning at an early age but is also extremely useful for pursuing education and career in sciences or engineering fields. Engineering and science courses at the undergraduate level have also grown to accommodate STEM learning principles.

Careers in STEM include Data Scientist, Data Analyst, Software Engineer, User Experience (UX) Designer, Machine Learning (ML) Engineer, and many others.

Education and career in space science requires students to be more rigorous and possess all-round knowledge of several related fields. Most careers in astronomy are research oriented and specialized, and thus students are encouraged to go for postgraduate and PhD programs for obtaining the best possible skillsets. Some careers in space science include astronomer, aerospace engineer, robotics and electronics engineer, cosmologist and cyber architect.

### Average salaries of some STEM and Space Science related job profiles:

Profile	Annual Salary in India (INR)	Annual Salary in USA(\$)
Astronomer	5-15 Lakhs	120,000
Cosmologist	8-10 Lakhs	130,000
Aerospace Engineer	8-10 Lakhs	105,000
Robotics & Electronics Engineer	5-20 Lakhs	100,000
Cyber Architect	20-50 Lakhs	135,000
Data Scientist	10-25 Lakhs	140,000
Machine Learning (ML) Engineer	7-15 Lakhs	112,000
User Experience (UX) Designer	7-15 Lakhs	106,000
Software Engineer	5-25 Lakhs	87,000
Data Analyst	5-25 Lakhs	115,000

### Why us?

Centre for STEM & Space Science is India's first dedicated coaching centre for STEM and astronomy education. We believe that space is the most important frontier for the future and exposure to the field of astronomy and space science through a streamlined and learner-oriented pattern will aid students in their path of choosing a career.

Our ideology is to put students through the process of learning, tapping into their inherent curiosity and skillsets to make maths and science much more enjoyable to learn.

Our intention is to inculcate the mind-set that research, innovation and development occur through a continuous process of experimentation and perseverance.

Keeping this in mind, Centre for STEM & Space Science has come up with co-curricular programs for STEM and Space Science education. Our team consists of experts in astronomy and STEM education.

We provide facilities such as STEM lab, library, career guidance and many more. We look to create an environment where instead of just working towards finite objectives, students will enjoy the process of learning throughout their journey.

### Our Plan:

Astronomy and space science are subjects about which students have inherent curiosity since a young age. Our plan is to tap into that curiosity to create a strong foundation so that they will be capable of acquiring the skills and knowledge necessary for their long-term progress. STEM & Space Science curriculum is designed keeping students in mind.

We intend to remove the preconceived bias that maths and science are notoriously difficult subjects to understand. Our team of experts has curated topics from astronomy for learners at every level.

## Benefits:

- Getting a formal introduction to Astronomy and Space Science
- Developing and fostering scientific and critical thinking
- Inducing independent thinking and creating aptitude for research
- Learning about the progression of Astronomy from an observational to a scientific field
- Training on handling and working of professional astronomical telescope
- Learning about various tools and techniques used by astronomers for observations and research
- Learning about the impact of Astronomy on daily life through technology transfer and applications
- Inculcating creative ideas in students through project based learning
- Space science exhibition at your school under the guidance of mentors and experts in the fields of astronomy and space science

## Implementation Plan

### a. Theory

Classroom sessions of streamlined curriculum with the help of graphics.

### b. Experiments

Hands on experiments and demonstrations for STEM and Space science

- Study of light & its phenomena
- Data Recording & graph plotting.
- Data Analysis
- Astronomical Time calculations, Day & year calculation
- Demonstration of relativity in Gravity.
- Observation of night sky through Telescope
- Observation of Constellations, stars, planets, Moon etc
- Satellite Communication
- Telescope making
- Many more practicals...

### c. Activities

Practical astronomy related activities for better learning.

[e.g. telescope making, Celestial map plotting, Identification, Sky map reading]

### d. Learning method

- Classroom sessions of curriculum with the help of graphics and videos
- Activities & Practicals based on specific theory topics which mainly includes practical astronomy.
- Interactive learning sessions
- Lecture Notes

### e. Assessment method

- Question-Answer sessions
- Self test questions
- Conceptual & mathematical problems

Periodical Theory & Practical tests

### f. Teachers arrangement

Our fully trained visiting faculty will conduct theory and practical. Our staff will be well equipped with practical material.

- g. Space Science and STEM Lab  
We will assist in setting up a STEM Lab that is designed for students to get hands-on practical experience. The lab facility will consist of:
- High performance computers
  - Interactive application software platforms
  - Circuit simulation platforms
  - Electromechanical components for tinkering
  - Arduino microcontrollers
  - Breadboards for testing circuits
  - PCB for assembly
  - Predesigned learning kits
  - Expert supervision and guidance

**Timeline:**

**For Astronomy and Space Science,**

Mode of Teaching	Months	Number of Hours/Sessions
Theory Lectures	July -August	20-25 hours (up to 4 hours per week)
Experiments/Activities	September	5 sessions
Q/A sessions & MCQ Tests	September	3-4 sessions
Stargazing	October -November	1-2 sessions
Space Science Exhibition	November	Event

**For STEM Activities,**

A total of 15 sessions every year will be conducted after discussions with school management

**Curriculum Grade 1 to 4**

**What are stars?**

- About stars
- Observing stars
- Shape, size and distance from us
- Temperature

**What are planets?**

- About planets
- Difference between stars and planets
- The eight planets

**Basic facts about the planets**

- Terrestrial planets
- Giant planets
- Moons and rings
- Rotation and revolution of planets

**About Earth**

- Earth's rotation
- Day and Night
- Sunrise and Sunset
- Revolution of Earth
- Features of Earth

**About Sun**

- The Sun as a star
- As a source of heat and light
- As a boon for life

**About Moon**

- The Moon
- Phases of the Moon
- Motion and orbit of the Moon
- Hands-on learning through clay models and paper pop-ups
- Drawing activities
- Videos and Images



## Grade 5

### Astronomy

- What is astronomy
- Ancient astronomy
- Great astronomers

### Eclipses

- Lunar Eclipse
- Solar Eclipse
- Causes

### The solar system

- The components of the solar system
- The planets and moons
- Asteroid belt
- Comets

### Observing the night sky

- Naked eye astronomy
- Light pollution and other observational issues
- Need of telescope
- Celestial bodies – Stars, planets, nebulae, galaxies

### Constellations and Sky maps

- What are constellations
- Common constellations
- Visible constellations according to seasons

### Satellites

- Artificial satellite
- Communication satellites

### Space Missions

- What are space missions
- History
- Some important missions

### Value of astronomy

- Historical importance of astronomy
- Ancient and medieval cultures

### Experiments and Activities:

- Propagation of light
- Transmission of light
- Sky observation using telescope
- Space science project

## Grade 6

### Earth

- Formation of Earth
- Earth's axial tilt
- Cycle of seasons
- Latitude and Temperature zones on Earth

### The solar system

- The Sun in the solar system
- Features of planets

### Constellations and sky maps

- Sky maps
- Historical importance of constellations
- Modern day usage

### Stars

- Types of stars
- Binary stars
- Giant stars

### Stars

- Observing stars
- Stars in our neighbourhood

### The Milky Way

- The Milky Way galaxy
- Observing the Milky Way

### Timekeeping

- Time as a physical measure
- History of timekeeping
- Meridians

### Space Exploration

- Need of space exploration
- Important space missions

### Satellites

- Need of satellites
- Weather satellites

### Experiments and Activities:

- Reflection of light
- Reflectance and colour of objects
- Sky observation using telescope
- Planning a space mission
- Space science project

## Grade 7

### The Sun-Earth-Moon system

- The Sun's gravitational effect
- The Moon and its formation
- Tidal effects on Earth
- Impact of the Sun and Moon on Earth's environment

### How to observe the Sun

- Problems with direct observation
- Indirect observation using mirrors and screens
- Direct observation using filters

### Stars

- Birth of stars
- Life cycle of stars

### The Milky Way

- Structure and classification
- Composition
- Regions

### Universe

- What is the universe
- The Big Bang hypothesis
- Evolution and history of the universe
- The Observable universe

### Time calculations

- Time zones
- Modern time keeping

### Satellites

- More about satellites
- Navigation and GPS

### Value of Astronomy

- Technological advancements
- Role in modern society

### Experiments and Activities:

- Understanding angular size of celestial bodies
- Reflection of light using plane mirrors
- Sky observation using telescope
- Observing the Sun using filters
- Space science project

## Grade 8

### Celestial Sphere

- Sky
- Celestial sphere
- Celestial coordinate systems
- Zenith, Nadir and Horizon
- Right ascension, declination
- Locating celestial bodies on the celestial sphere

### Terrestrial planets

- Atmosphere and interiors of terrestrial planets
- Exploration of Mercury
- Exploration of Venus
- Exploration of Mars
- Future colonization

### Jovian planetary systems

- Atmospheres and composition of Jovian planets
- Exploration of Jupiter and its moons
- Exploration of Saturn - Rings and Titan
- Planned Exploration of Ice Giants

### The Sun and solar physics

- The engine of the Sun
- The Solar photosphere and atmosphere
- Solar activities
- Sunspots

### Galaxies

- What are galaxies?
- Galaxy classification

### Exoplanets

- Exoplanets
- Discovery
- Detection techniques

### Experiments and activities:

- Understanding measurements in astronomy
- Celestial sphere
- Sky observation using telescope
- Stargazing session
- Space science project

## Grade 9

### Earth science and space physics

- Earth's atmosphere
- Earth's magnetic field
- Solar wind
- Effects on Earth
- Role in the evolution and survival of life
- Impact on satellites and space travel

### The Outer Solar system

- Beyond Neptune
- Pluto and the dwarf planets
- The Kuiper Belt
- The Oort Cloud

### Evolution of stars

- Nebulae and star forming regions
- Protostars
- Main sequence stars
- Nucleosynthesis

### Galaxies

- Composition of galaxies
- Normal and Active Galaxies

### Introduction to Space Propulsion

- Laws of motion
- Physical forces
- Gravity on Earth
- Propulsion

### Telescopes

- Need of telescopes
- Types of telescopes
- Working

### Experiments and Activities:

- Working and efficiency of solar power
- Refraction of light
- Studying the HR Diagram
- Working of telescope
- Stargazing session

## Grade 10

### Non-optical astronomy

- The electromagnetic spectrum
- Radio and Microwaves
- Infrared astronomy
- Ultraviolet and x-rays

### Evolution of stars

- Nucleosynthesis after Helium
- Supergiant phase
- Death of stars – Planetary Nebula, Nova and Supernova

### Compact objects

- White dwarfs
- Neutron stars and pulsars
- Black holes

### Active galaxies

- Active Galactic Nuclei
- Radio galaxies
- Seyferts
- Quasars

### Cosmology

- Studying the universe
- Need of cosmology
- Redshift and Cosmic Microwave
- Background
- Timeline of the universe

### Space Propulsion

- Jet propulsion
- Rocket propulsion
- Types of rocket engines
- Importance

### Experiments and Activities:

- Working of focusing mirrors
- Properties of electromagnetic waves
- Understanding propulsion
- Sky observation using telescope
- Stargazing session
- Space science project

## STEM Learning

### Grade 5

- Introduction to logic
- Basic hardware
- Circuits
- Machines
- Need of automation

### Grade 6

- Models and simulation
- Energy transfer
- Efficiency
- Basic Electronics
- Assembly

### Grade 7

- Software
- Introduction to coding
- Introduction to block coding
- Circuit components
- Robot design

### Grade 8

- Data and data processing
- Digital electronics & microcontrollers
- Sensors and data acquisition
- Arduino
- Coding and maths

### Grade 9

- Computing techniques
- Optimization
- Machine Learning
- Introduction to Jupyter Notebooks
- Robot programming

### Grade 10

- Robot assembly
- Artificial Intelligence
- Internet of Things
- Control systems
- Python Coding

We will assist in setting up a STEM Lab that is designed for students to get hands-on practical experience. The lab facility will consist of:

- High performance computers
- Interactive application software platforms
- Circuit simulation platforms
- Electromechanical components for tinkering
- Arduino microcontrollers
- Breadboards for testing circuits
- PCB for assembly
- Predesigned learning kits
- Expert supervision and guidance

**Mode of Action:  
For Astronomy education,**

<b>Mode of Teaching</b>	<b>Months</b>	<b>Number of Hours/Sessions</b>
Theory Lectures	July -August	20-25 hours (up to 4 hours per week)
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**For STEM activities,**

A total of 15 sessions every year will be conducted after discussions with school management

**Services we provide:**

- Expert Guidance
- Library
- Lab services
- Project Kits
- Olympiad Guidance
- Study material
- Stargazing

**Benefits:**

- Acquire new STEM skills
- Increased knowledge base through space science
- Handling and working of professional astronomical telescope
- Understand and design new systems
- Identifying problems and finding solutions
- Project based learning
- Increased involvement in maths and science
- Learn about the boon of technology transfer
- Exposure to Coding, IoT, Machine Learning
- Space science exhibition
- Cognitive Thinking
- Research Aptitude
- Problem Solving
- Logical Reasoning
- Creative Ideation
- Practical Approach
- Scientific Temperament
- Interpersonal skills
- Decision Making
- Troubleshooting
- Become Future Ready

## Fee Structure

Fees are charged per student basis  
It is negotiable depending upon the number of students participating

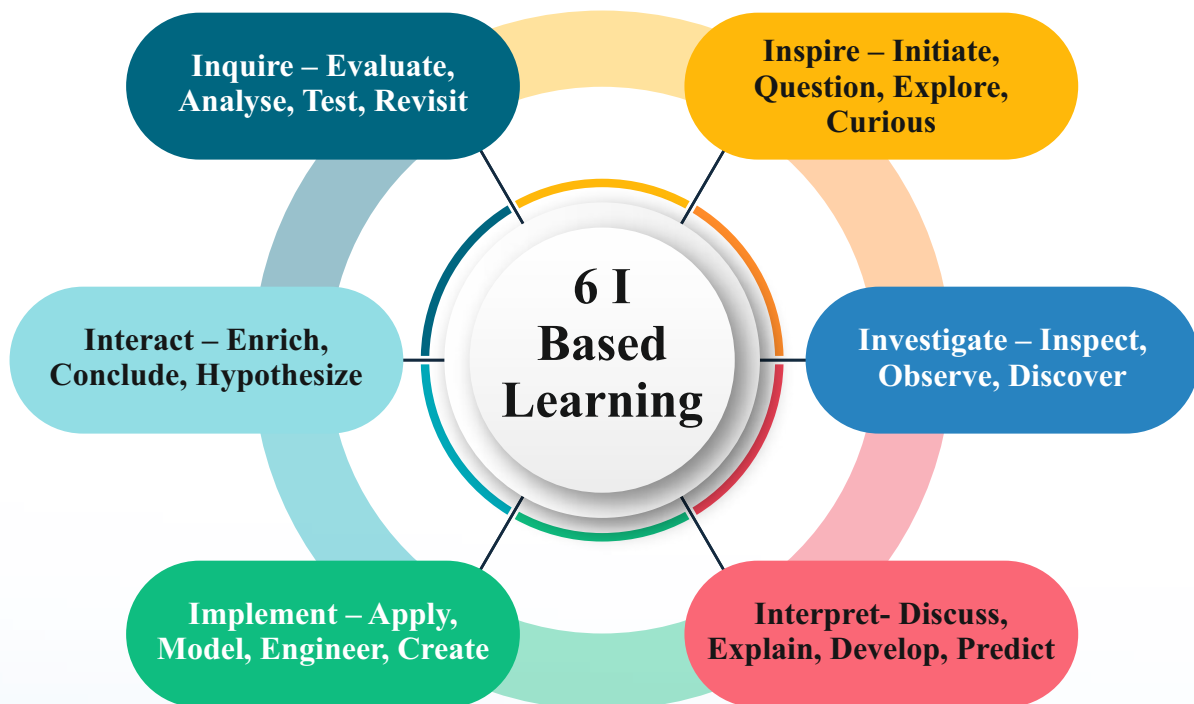
Space Science	Grade 1 to 4: Rs 1000	Grade 5 to 7: Rs 1500	Grade 8 to 10 : 2000
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STEM Programme	Grade 1 to 4 : RS 500 + kit charges extra
	Grade 5 to 7 : Rs 700 + kit charges extra
	Grade 8 to 10 : Rs 1000 + kit charges extra

**Star Gazing** : Full night star gazing at suitable time at nearby location in your area

Charges: approx. Rs 2000 to 3000 per person \*

- \*It will be decided in meeting



## Contract:

We will be very pleased to have approval from you for this exceptional academic journey of the students. After going through the programme information, if you wish to collaborate with us in running the programme at your school we have to sign a contract with better mutual understanding and agree upon terms and conditions. Please fill out the details below:

School Name: .....

Address : .....

Name of Authority: .....

Designation: .....

Student Strength: .....

### Programs and Services of Interest:

Space Science Programs:

Grade 1-4       Grade 5-7       Grade 8-10

STEM Programs:

Grade 5-7       Grade 8-10

Library:  Space Science and STEM Lab:  Telescope for Observation:  Stargazing Sessions:

### Terms & Conditions:

1. The terms 'classes' and 'classroom' are made considering a maximum capacity of 50 students. This is to make optimal use of the ICT model of teaching for the benefit of students and teachers.
2. The terms 'lab' and 'lab sessions' are made considering a maximum capacity of 25 students per session. This is to ensure that every student gains an opportunity to handle experiments.
3. If the designated teacher is unable to conduct a session due to any personal issues on their behalf, we will appoint another teacher as a replacement and the session will be conducted as per schedule.
4. If classes have to be rescheduled due to any reason on behalf of the school or school management then it is solely the responsibility of the school to make sure that the rescheduling is done at the appropriate time so as to complete the syllabus.
5. 50% of the payment of the programme will have to be completed in advance.
6. The aforementioned total number of teaching hours required to complete the syllabus must be planned and designated in advance and school authority should make sure availability of time as per schedule.
7. Lecture notes and study material will be accessible to students in PDF format at no extra cost.
8. The books provided to students through the library facility must be returned in 10 days from date of issue or renew the issue. Any loss or damage must be reported to Centre management immediately.
9. Centre can provide telescope on school campus for observation purposes. The handling of telescope must be done under expert supervision only. While telescope is on school campus, it is the responsibility of the school and any damage or mishaps are the liability of the school.

Signature :

Date :

Place :



॥ ऋते ज्ञानान् मुक्तिः ॥

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