AWES Space and Astronomy Laboratory

Introduction:

New discoveries in astronomy in recent years have generated a lot of excitement globally, and Indian scientists have contributed to them in large measure. However, the country is lacking when it comes to promoting astronomy education at different levels and the number of professional astronomers it needs just a handful of 700-odd universities teach astronomy and astrophysics at post graduate and research levels. The number of undergraduate colleges with courses in astronomy and astrophysics is miniscule and at the school level, astronomy does not figure in curriculum. This was stated by Prof S K Pandey, President of the Astronomical Society of India.

With the AWES Space and Astronomy Lab, the main goal is to inspire and educate the students in the field of Astronomy, STEM & Space Science and encourage them for Space Exploration which will create a new generation of advanced scientists, engineers, and astronauts. The aim is to create opportunities for hands-on learning through physical experiments, which can harness scientific temperament and inculcate rational thinking amongst students.

OBJECTIVES:

The aim of this initiative is to setup a Space and Astronomy Lab at all the AWES schools with the following objectives:

- To provide students with an exposure of Astronomy and Space Science Education.
- To develop scientific thinking skills, logical and critical thinking skills.
- To introduce and expose students to technical skills required for astronamy such as data analysis and sensor technology.
- To get equipped with information about potential career paths is astronomy and space science.
- To understand basic celestrial dynamics, reading the night sky and observation of celestrial objects through telescopes.

Contents of the Space and Astronomy Lab

1. 60 MM aperture Refractory Telescope:

Activities:

- Assembly and setup of Telescope on Mount
- Understanding the Equatorial mount Manual controls and tracking of celestial objects
- Viewing the moon in different phases
- Using a camera to capture images from the telescope.
- Reading star chart/sky chart. Optics of the telescope and how

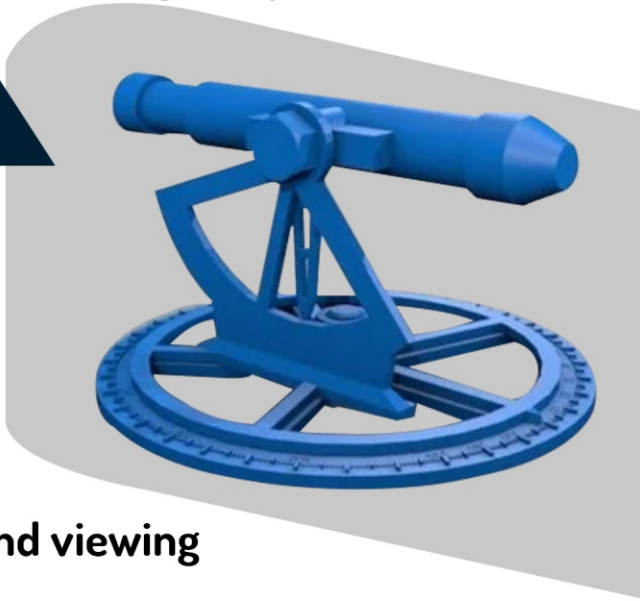
Outcomes:

- Able to work out telescope optics, lens requirements of objective and eye piece
- Able to understand noise and pollution in the light of looking at space objects including light pollution
- Able to see track and record observations on nearby large objects like moon, Venus and Mars
- Able to track object being observed as the earth rotates: use an equatorial mount
- Able to read star charts and adjust for local viewing

Recommended for grades:

- Grades 3 and above
- Grade 3 and 4 to be assisted by a teacher
- Grade 5 can be taught about the loading and following of a planet.

Theodolite/Sextant:



Activities:

-Use parallax to measure distance to the moon and perhaps Mars.

Outcomes:

- Able to understand the method of parallax and viewing with different vantage points
- Able to understand and apply triangulation methods

Recommended for grades: Grades 7 and above

114 mm reflecting Newtonian Telescope with filters:

Activities:

- This is an advanced reflecting telescope.
- With this several deep sky objects and stars can be viewed.
- Star and asteroid hunts may also be conducted. The sun may be viewed in great detail (using filters)
- Collimation of the telescope

Outcomes:

- Able to adjust and track small solar objects
- Able to view and photograph observations.

Recommended for grades: Grades 8 and above

Planisphere:

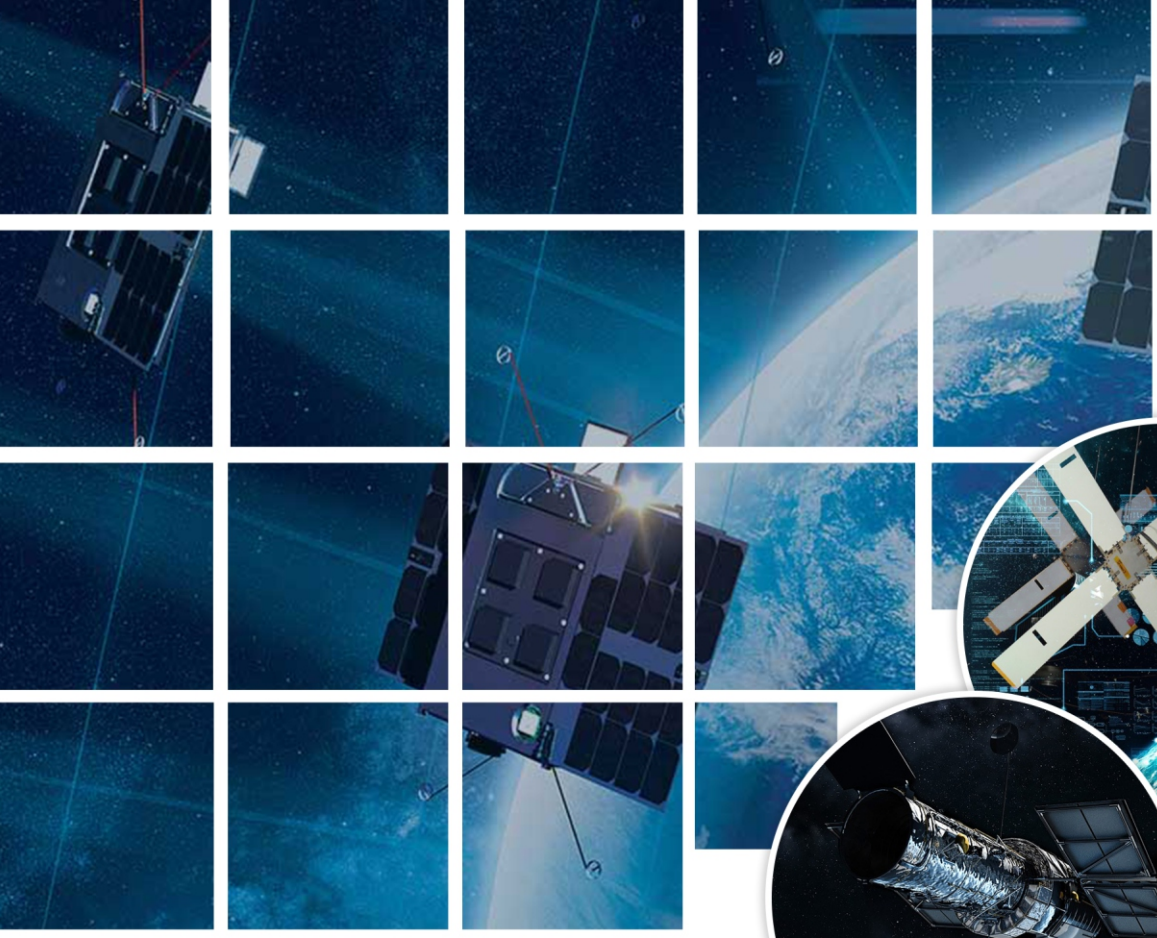
Activities:

- Students can vary and adjust the planisphere as per time, date and month.
- Students are able to see the stars that are technically visible at that given point of time.
- They will compare the chart against the visible sky

Outcomes:

- Students will be able to correlate the visible stars/planets and constellations against the time, date and month.
- Look and physically verify the shapes of the constellations.

Recommended for grades: Grades 5 and above



Nano-satellite kit:

Activities:

-Students can simulate and setup a satellite transmission and reception in their own lab (base station).
- They will vary the ambient parameters in the lab (light, temperature, motion) on the satellite kit to visualize the data being logged on the base station software
- For higher classes, they can write basic code to setup alerts

Outcomes:

- Students will learn the structure and components of a basic satellite kit.
- The process of communication between satellites and base stations.
- View how base station visualization works.
- Code basic satellite experiments, such as data transfer and data logging

Recommended for grades:

- 5th and grade to see basic communication and change parameters to view base station applications.
- 7th grade to do basic coding of the transmission and base station experiments.

Virtual reality space experience with headset:

Activities:

-Students will be transported to the world of a spacecraft pilot and fly the craft in a virtual reality environment of our solar system.
- They will explore all the planets in the solar system and also learn about the various fun facts and educational aspects of planets, moons and asteroids

Outcomes:

-Students will learn and visualize the structure of our solar system
- Through VR, they can explore the planets up close and in 3D.
-They will learn about the various aspects of the planets in our solar system.

Recommended for grades: Grade 4 and above

Replica surface of the Moon and Mars assisted with an interactive Augmented reality experience:

Size of the surface: 2ftx2ft

Activities:

- Students will be able to view a replica surface of the moon and mars
- View, touch physical craters and rocks
- Using the AR app with it, they can visualize how a rover moves on the surface
- Using the AR app they can visualize how various spaceships landed on the moon

Outcomes:

-Students will learn and appreciate how the surface and terrain of the moon and mars looks like.
-They will be able to visualize the landing of a module on moon and rover o mars

Recommended for grades: Grade 3 and above

3d printed Space rover kit:

Activities:

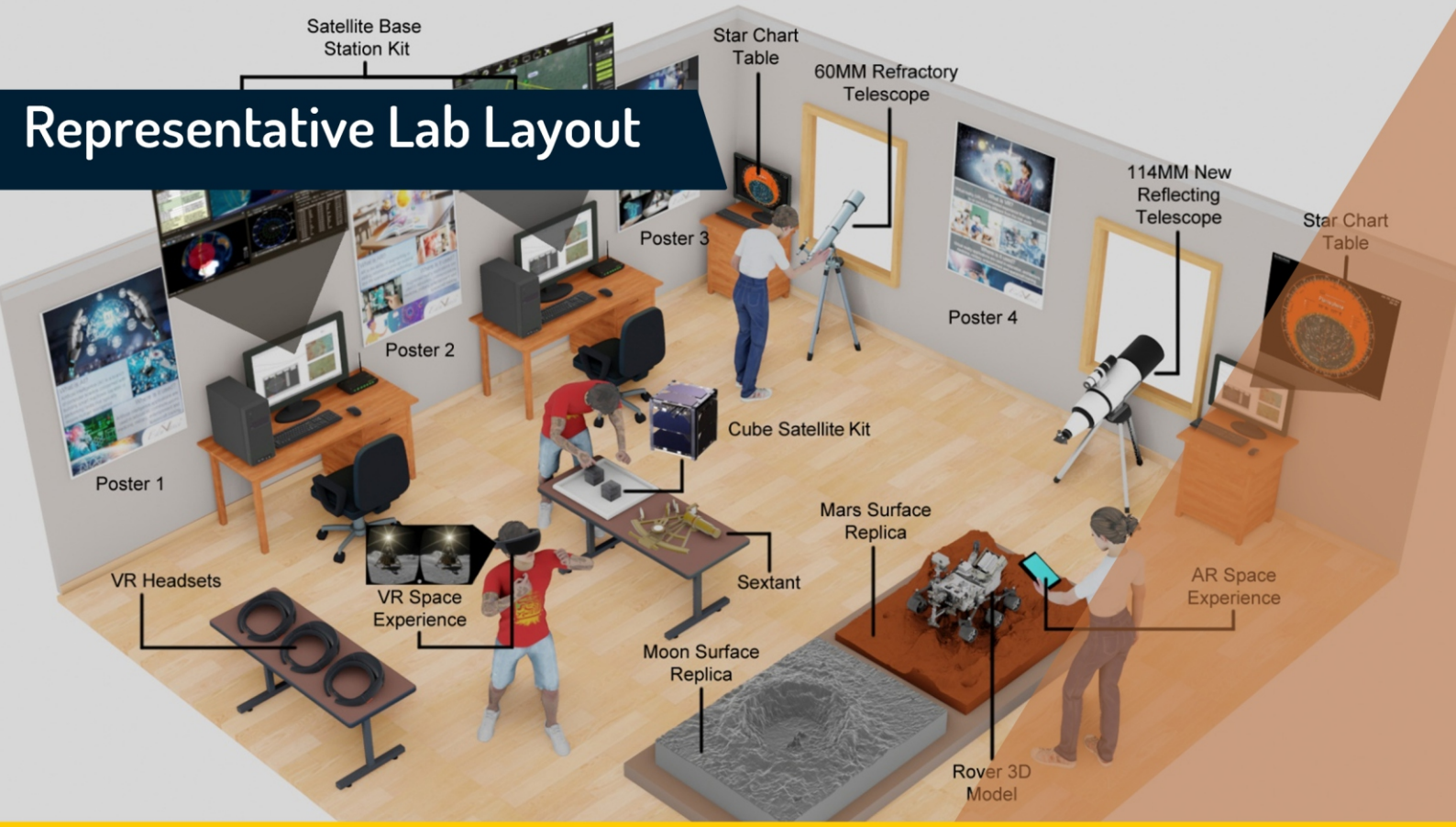
- Assemble a 3D printed model of a Rover used for space missions.
- Study the rover and about its parts and functioning using augmented reality

Outcomes:

- Students will learn about the various parts of a mars rover
- Visualization of a rover using Augmented reality.
- Able to understand the AR technology.

Recommended for grades: Grade 3 and above

Representative Lab Layout



Please note: The lab layout and dimensions are representative in nature. Placement of equipment can vary based on the school's room configuration.

Grade wise activity mapping for various lab components

Lab Material to Grade mapping	Gr. 3	Gr. 4	Gr. 5	Gr. 6	Gr. 7	Gr. 8	Gr. 9	Gr. 10	Gr. 11/12
60 MM Refractory Telescope	✓	✓	✓	✓					
Virtual reality experience software for various spaceships	✓	✓	✓	✓					
3d surface of the moon and mars	✓	✓	✓						
3d printed rover		✓	✓	✓					
Theodolite/Sextant					✓	✓			
114 mm reflecting Newtonian Telescope						✓	✓	✓	✓
Planisphere			✓	✓	✓	✓			
Nano Satellite kit			✓	✓	✓	✓	✓	✓	✓

Detailed specifications and Quantity of Lab items

Item	Detailed Specification	Quantity
60 MM aperture Refractory Telescope	- 60mm Aperture, 2 lens based Fraunhoffer with focal length 700mm, Barlow lens 1, a finder 5X24 and a standadrd eyepiece of 0.965". Must use a rack and pinion focusing arrangement - This device focuses a lot of light. Looking directly at the SUN through this device can result in partial or complete loss of vision. Please ensure the Solar filter supplied along with is in place during the day. - Must be able to give practical magnification of 120X and resolution of 2.5 Arc-seconds. - Teach the fundamentals of Galiliean telescopes that student read about in science; Changing of focal length, effective focal length and the use of Barlow lenses - Teach students to view locate and track objects in the night sky using starcharts and the plansiphere - Teach students the value and methods of looking after optical instruments - Teach students the method of mapping the night sky using the azimuthal grid	01
Theodolite/Sextant for determining distance to planets/moon parallax method	- The theodilite is an XYZ axis instrument useful for estimating ditances. Wuth garduated degreee markings, each axis has a reoilution of 0.5 degrees. Shipped as a kit, will need to be assembled by students. Material is Biodegradable plastic - Teach students the meaning of parallax -Teach students the method of triangulation to find large distances - Teach students teamwork and coordination in measuring the distance to the moon as measured from two different latitudes - Students learn how to calculate time offsets with longitude	02
114 mm reflecting Newtonian Telescope	- Newtonian Reflector telescope with a 4.5" aperture enabling the viewing of deep sky objects. Must have the following: Focal length 500 mm and resolution 1 Arc second. Solar filter for safety, Galaxy 1.25 " eyepiece, in addition to standadard eyepeice, 2 Barlow lenses, a collimation tool, - Mounting: sturdy EQ3 eqautorial Mount with manual tracking and slow motion moevement along RA DEC coordinates. Also included are Messier object Charts and an Orion Nebula Poster	01

Planisphere	- Planisphere is a useful tool for locating stars. Must have starc hart size 4" dia fitted for a latitude (works within +/- 2.5 deg). This sturdy 3 D printed version must be openable for changing the star chart. Material must be biodegradable plastic	02
Nano Satellite kit	- LoRA (long range) based nano satellite kit with range of upto 1km LOS (line of sight) - Cube satellite kit with transmitter satellite (Cubesat) and base station module - Transmitter module must have temperature, light and motion sensors integrated - Students must be able to vary the sensor values - Base station module must be accompanied with base station visualization software - Transmitter should be programmable using Arduino programming platform - Students must be able to configure and set logic for the transmitter and receiver module to perform various data monitoring space simulations	03
VR headset kit + Virtual reality experience software for various spaceships	-VR Software: - Spaceship flying simulator for the solar system - Must cover all the planets of the solar system - Asteroid belt - Reticle based Interactive text information to be displayed so that educational information is automatically displayed once the student looks at a particular planet - Audio integration feature - Seamless integration of the software with the bluetooth headset specified VR headset where students can - Insert the mobile phone into the headset Bluetooth remote that has the following functionality - 360 degrees joystick - 2 pairing modes - 4 mode buttons - 2 configurable joysticks	05
3d printed surface of the moon (4 sq ft)	- 3D printed surface of the moon that is at par with NASA imagery and 3d models. The 3D printed model must be of the same colour as the Moon's surface - 3D printed surface must be in 1 sq ft modules that must be interconnected using dowel connectors - The 3d printed surface must be accompanied with an augmented reality application that can show students, the landing of a spacecraft on the 3d printed surface.	01

3d printed rover	- A kit that contains the various 3d printed parts of the curiosity Mars rover that is at par with NASA's imagery and 3d models - The 3d kit must contain the following parts - The 3d kit must contain the following parts: 6mm-pin. 17 body. 1 tire. 6 wheel. 6 lower-suspension. 1 upper-suspension 1 mounting-bracket. 2 steering-bracket. 4 swivel-bracket. 1 swivel. 1 upper-arm. 1 lower-arm. 1 mahli-apxs. 1 chemcam. 1	01
Laminated Lab Posters (Size: A1)	- A1 size laminated posters depicting images and description of the following components - Solar system - Cube satellites - Telescopes - Curiosity Rover - Moon surface - Mars surface - Space fun facts 1 - Space fun facts	08