Unit 4 Tools of the Astronomer

Content Area: **Science**
Course(s): **Astronomy 1**
Time Period: **December**
Length: **6 weeks**
Status: **Published**

Transfer Skills

Transfer:

Students will be able to connect the concepts of radiation and the electromagnetic spectrum to the use of historical and newly-developed observational tools.

They will be able to distinguishthe various methods of measuring astronomical distances and apply each in appropriate situations.

Enduring Understandings

Understand how telescopes aid astronomers and the importance of observing at other wavelengths.

Understand the properties of Telescopes

Identify the types of Optical Telescopes

Discuss how the collecting area and how larger areas allow viewing of dimmer objects

Discuss the impact of increasing resolution and how that allows finer details to be seen

Discus show both collecting area and resolution depend on the size of the mirror or lens.

Essential Questions

What is the main difference between a refracting and a reflecting telescope?

Which one is in more common use today?

What advantages does observing from space give to the astronomer?

How do radio and x-ray telescopes work?

Content

Voc. Terms:

refracting telescope, reflecting telescope, focal plane, aperature, index of refraction, concave, convex, resolution, diffraction, quantum efficiency, radio telescope, infrared telescope, flyby, landers, rovers

Skills

Compare and contrast the two main types of optical telescopes, and summarize how these telescopes utilize the behavior of light.

Describe how telescopes of various types collect radiation over the range of the electromagnetic spectrum.

Explain the advantages and disadvantages of ground-based telescopes and telescopes in orbit.

Summarize why spacecraft are sent to studey the planets and moons of our Solar System.

Recount how particle accelerators, neutrino and gravational-wave detectors, and high-speed computers contribute to the body of information we have about the universe.

Discuss the types of observations that led to the discovery of leftover radiation from the big bang.

Resources

Standards

NGSS: Science Performance Expectations(2014)
NGSS: MS Earth & Space Science
MS.Space Systems
Performance ExpectationsShow details

- MS-ESS1-3. Analyze and interpret data to determine scale properties of objects in the solar system.Show details

NGSS: MS Engineering Design
MS.Engineering Design
Performance ExpectationsShow details

- MS-ETS1-1. Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.
- MS-ETS1-4. Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved..

NGSS: Science and Engineering Practices
NGSS: 9-12
Practice 1. Asking questions (for science) and defining problems (for engineering)
Asking questions and defining problems in 9–12 builds on K–8 experiences and progresses to formulating, refining, and evaluating empirically testable questions and design problems using models and simulations.
Ask questions that arise from careful observation of phenomena, or unexpected results, to clarify and/or seek additional information.

Ask questions that arise from examining models or a theory, to clarify and/or seek additional information and relationships.

Ask questions to determine relationships, including quantitative relationships, between independent and dependent variables.

Practice 2. Developing and using models
Modeling in 9–12 builds on K–8 experiences and progresses to using, synthesizing, and developing models to predict and show relationships among variables between systems and their components in the natural and designed worlds.
Develop and/or use multiple types of models to provide mechanistic accounts and/or predict phenomena, and move flexibly between model types based on merits and limitations.

Practice 4. Analyzing and interpreting data
Analyzing data in 9–12 builds on K–8 experiences and progresses to introducing more detailed statistical analysis, the comparison of data sets for consistency, and the use of models to generate and analyze data.
Analyze data using tools, technologies, and/or models (e.g., computational, mathematical) in order to make valid and reliable scientific claims or determine an optimal design solution.

Practice 5. Using mathematics and computational thinking
Mathematical and computational thinking in 9-12 builds on K-8 experiences and progresses to using algebraic thinking and analysis, a range of linear and nonlinear functions including trigonometric functions, exponentials and logarithms, and computational tools for statistical analysis to analyze, represent, and model data. Simple computational simulations are created and used based on mathematical models of basic assumptions.
Apply ratios, rates, percentages, and unit conversions in the context of complicated measurement problems involving quantities with derived or compound units (such as mg/mL, kg/m3, acre-feet, etc.).

Practice 7. Engaging in argument from evidence
Engaging in argument from evidence in 9–12 builds on K–8 experiences and progresses to using appropriate and sufficient evidence and scientific reasoning to defend and critique claims and explanations about the natural and designed world(s). Arguments may also come from current scientific or historical episodes in science.

Evaluate the claims, evidence, and/or reasoning behind currently accepted explanations or solutions to determine the merits of arguments.

NGSS: Crosscutting Concepts
NGSS: 9-12
Crosscutting Statements
1. Patterns – Observed patterns in nature guide organization and classification and prompt questions about relationships and causes underlying them.
Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena.

Mathematical representations are needed to identify some patterns.

Empirical evidence is needed to identify patterns.

2. Cause and Effect: Mechanism and Prediction – Events have causes, sometimes simple, sometimes multifaceted. Deciphering causal relationships, and the mechanisms by which they are mediated, is a major activity of science and engineering.
Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.

3. Scale, Proportion, and Quantity – In considering phenomena, it is critical to recognize what is relevant at different size, time, and energy scales, and to recognize proportional relationships between different quantities as scales change.
Using the concept of orders of magnitude allows one to understand how a model at one scale relates to a model at another scale.

4. Systems and System Models – A system is an organized group of related objects or components; models can be used for understanding and predicting the behavior of systems.
Models (e.g., physical, mathematical, computer models) can be used to simulate systems and interactions—including energy, matter, and information flows—within and between systems at different scales.

7. Stability and Change – For both designed and natural systems, conditions that affect stability and factors that control rates of change are critical elements to consider and understand.
Much of science deals with constructing explanations of how things change and how they remain stable.

NGSS: Disciplinary Core Ideas
NGSS: 9-12
ESS1: Earth's Place in the Universe
ESS1.A: The Universe and Its Stars
Other than the hydrogen and helium formed at the time of the BigBang, nuclear fusion within stars produces all atomic nuclei lighterthan and including iron, and the process releases electromagneticenergy. Heavier elements are produced when certain massive stars achieve a supernova stage and explode. (HS-ESS1- 2),(HS-ESS1-3)

ESS1.B: Earth and theSolar System
Kepler's laws describe common features of the motions of orbiting objects, including their elliptical paths around the sun. Orbits may change due to the gravitational effects from, or collisions with, other objects in the solar system. (HS-ESS1-4)

Cyclical changes in the shape of Earth's orbit around the sun,together with changes in the tilt of the planet's axis of rotation, both occurring over hundreds of thousands of years, have altered the intensity and distribution of sunlight falling on the earth. These phenomena cause a cycle of ice ages and other gradual climatechanges.

(secondary to HS-ESS2-4)

PS2: Motion and Stability: Forces and Interactions
PS2.A: Forces and Motion
If a system interacts with objects outside itself, the total momentum of the system can change; however, any such change is balanced by changes in the momentum of objectsoutside the system. (HS-PS2-2),(HS-PS2-3)

PS2.B: Types of Interactions
Forces at a distance are explained by fields (gravitational,electric, and magnetic) permeating space that can transfer energy through space. Magnets or electric currents cause magnetic fields; electric charges or changing magnetic fields cause electric fields. (HS-PS2-4),(HS-PS2-5)

SCI.HS-ESS1-3	Communicate scientific ideas about the way stars, over their life cycle, produce elements.
SCI.HS-ESS1	Earth’s Place in the Universe
SCI.HS-ETS1	Engineering Design
SCI.HS-ETS1-4	Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.
SCI.HS-ETS1-1	Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.