POINTFUL EDUCATION

Aeronautics and Space Travel

Syllabus

» Course Overview

This course introduces students to the history and near future of space travel. Students will explore the possibilities of moon bases, Mars colonies, and visiting the outer planets in our solar system and their moons. Students will also discuss important ethical and legal issues around space exploration, such as asteroid mining and war in space. The course gives an expansive view of the technologies, science, and theories that will make far-fetched dreams into realities during the student's lifetime.

» Course Outline by Module

Module 1	Introduction to Space Travel	**Module 6**	Asteroid Mining
Module 2	Apollo and Shuttles	**Module 7**	Solar System Exploration
Module 3	International Space Station and Satellites	**Module 8**	Robots and War in Space
Module 4	Moon Base	**Module 9**	Spacecraft Technology
Module 5	Mars Colony	**Module 10**	Interstellar Travel

» Module Overview and Learning Objectives

Module 1. Introduction to Space Travel

At the beginning of the 20th century, space travel seemed like an impossible dream, one that had been on the mind of writers, poets and inventors for thousands of years. The first recorded mention of “space crafts” appeared in the Hindu poem Ramayana, written over many centuries starting in the 3rd century BC. It described machines capable of flying in and outer space. This was followed by many other examples but it wasn’t until the 17th century that a writer described travelling to the Moon. Now, 300 years later, serious plans are being considered to put human boots on Mars.

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This module looks at the fascinating history of space travel identifying its origins, prominent figures, key innovations, and technological advances. Students will look at how politics impacted space travel between countries and within countries while reviewing successes and challenges of the space program. The module will also preview exciting topics that will be covered throughout the course on the possibilities of space travel during the students' lifetime.

***Learning Objectives*:** In this module, students will:

- Outline the history of space travel and contrast past technological changes with current opportunities
- Analyze the political history of space travel and its impact on innovation.
- Discuss the challenges space travel has faced over the last century and the solutions which overcame them
- Construct a timeline of innovation, technological advances, historical turning-points, successes, and failures within the last century identifying prominent figures which impacted space travel
- Preview the goals, plans, and possibilities for space travel over the next 50 years, including moon and Mars exploration, space tourism, and asteroid mining

Module 2. Apollo and Shuttles

In this module, you will learn about key moments in the history of space travel and exploration. We will drill down into the accidents and failures that lead to the successes we know today. Throughout, we'll focus on specific eras and projects to see what they achieved and the kinds of obstacles they faced. Along the way, you'll meet some of the astronauts who tasted victory and learn the names of those who paid the ultimate price while trying to expand humankind's understanding of the galaxy.

You'll also learn that putting humans into space might get the most media interest, but that some of the biggest scientific discoveries have been made by probes and telescopes. We'll also take some time to look more closely at some of the biggest failures of the space age. So, buckle up, it's going to be an interesting and bumpy ride.

***Learning Objectives*:** In this module, students will:

- Compare and contrast the space programs in China, the U.S, and the Soviet Union/Russia identifying time periods of competition between these entities
- Discuss the Apollo Missions and their benefit to space travel today
- Evaluate the construction of Space Shuttles over time and the innovations which have led to today's Space Shuttle
- Analyze a sample of failed space missions and the mechanical or human error associated with the failure.
- Discuss successful space missions and their significant impact on history

Module 3. International Space Station and Satellites

In this module, we'll look at the history of space stations before the ISS, discover the political context surrounding its creation, learn about the day in the life of an ISS crew member, and then switch gears to look at satellites, what technological impact they have had and how they have changed the military.

***Learning Objectives*:** In this module, students will:

- Discuss the history of space stations before the International Space Station.
- Analyze the role of international politics in the creation of the International
- Space Station.
- Describe a typical day in the life of an astronaut aboard the International
- Space Station.
- Construct a timeline of the introduction of satellites into space.
- Discuss the technological advancements made possible by satellites.
- Evaluate how satellites have impacted the military in superpower countries.

Module 4. Moon Base

In this module, we'll look at the history of the Moon, how it was formed in relation to the Earth and how its gravity influences our planet. We'll even imagine a world without the Moon. Then, we'll look at the possibility of building a base on the Lunar surface and think about the advantages and the disadvantages of that idea.

From scientific to commercial benefits, tourism opportunities and a stepping stone to explore the rest of the universe, the Moon is filled with possibilities. But it's not that simple. Is humanity ready to settle on other celestial bodies? Has it learned from the lessons of life on Earth? Can countries and commercial organizations get along and cooperate to make space exploration beneficial for everyone? Those are some of the questions we'll be trying to answer in this module.

***Learning Objectives*:** In this module, students will:

- Discuss the present and historical impact of the Moon on Earth.
- Analyze the geographic features of the Moon and the advantages/disadvantages of building a base on the Moon.
- Evaluate the political and future innovative benefits of placing a base on the Moon.
- Identify the physiological requirements for those residing on a Moon base.
- Analyze the impact of a Moon base to future colonization of Mars and other planets.
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Module 5. Mars Colony

In this module, we'll look at the history of Mars, how it was formed, and how its position in our solar system have contributed to it becoming the Red Planet. We'll see current theories about the possibility of life on Mars in the past and its ability to sustain life now, which is a crucial piece of the puzzle for those who want to colonize it.

As you can imagine, it won't be easy. You'll have a chance to examine the many requirements to colonize Mars successfully. From transportation to supplies and medical aid, and what humans would have to endure if they set foot on what appears to be a very hostile environment based on what we know so far.

Finally, we'll look at the plans for a future Mars colony being drawn up by many countries and commercial companies like SpaceX. Will it be the mid-2030s when Mars is closest to Earth? Let's find out!

***Learning Objectives*:** In this module, students will:

- Discuss the historical evidence of the ability of Mars to sustain life.
- Analyze the current theories on colonizing Mars.
- Identify the infrastructure required to provide transportation, supplies, and medical aid to a Mars Colony.
- Identify the physiological requirements for those residing on a Mars Colony.
- Construct a timeline of colonization theories and future predictions around a successful Mars Colony.

Module 6. Asteroid Mining

Planets, moons, and stars were once the only celestial bodies we heard about. But not anymore! Asteroids have found their way to the top of the topic pile. Here's why.

Considering our solar system has millions of asteroids, it's surprising they didn't get more attention until recently. Several factors have contributed to changing that. First, asteroids contain a lot of history. They were formed at the same time as the planets in our solar system and many asteroid fragments, called meteorites, have fallen to Earth where they can be examined.

A second important factor is the protection of our planet. Tracking existing asteroids is vital to ensure that we have an advanced warning if one is on a collision course with Earth. NASA, among others, is designing possible solutions to deflect or destroy asteroids which could hit Earth.

Finally, this module discusses the concept of asteroid mining, its economic benefits, and perceived cost. Students will learn about the leaders in the asteroid mining thought industry, how asteroid mining will be done, and identify both technical and legal barriers to its inception.

***Learning Objectives*:** In this module, students will:

- Discuss the formation of asteroids and present their different types and locations.
- Understand the economic benefits to asteroid mining including perceived cost and value.

- Identify the leaders in the asteroid mining industry and describe their potential role in future asteroid mining.
- Describe the current theories on the process of asteroid mining.
- Discuss the legal and ethical challenges presented in asteroid mining.

Module 7. Solar System Exploration

In this module, we'll go way beyond our nearest neighbors, the Moon and Mars. We'll take a closer look at and consider other planets, such as Jupiter and Saturn and their moons as potential sites for colonization.

Would Venus be suitable for human exploration or habitation? Do the moons of Jupiter or Saturn contain water, and would they ever support human colonies? Could these celestial bodies be launching points for deep space and interstellar travel?

This module will also discuss the increasing difficulties and logistical challenges of expanding our reach further away from the comfort of planet Earth.

***Learning Objectives*:** In this module, students will:

- Describe the climate and conditions on the planet Venus and discuss the possibility of terraforming or creating floating cities on Venus.
- Identify Jupiter's moons, including the 4 Galileo moons, and evaluate their potential for sustaining life and colonies.
- Compare the distances required to travel within our solar system and describe limitations given current technology.
- Describe the importance of water in space travel.
- Identify other moons, planets, and bodies at Saturn and beyond that could support colonies.

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Module 8. Robots and War in Space

Not so long ago, space was seen as a mystery. Space exploration has opened up a new frontier filled with discoveries and represents an exciting development in the progress of humankind. Just think of all the facts about space you learned even in your short life. It's been a wonderful journey so far.

Unfortunately, if human history repeats itself, the discovery of new frontiers often leads to new competition between countries to access and control resources and a desire for technical supremacy.

This module will explore the many questions around the possibilities of war in space. We will also look into how robots are or could be used, for both exploration and warfare.

***Learning Objectives*:** In this module, students will:

- Summarize the principles of the Outer Space Treaty
- Describe plans by the U.S. military and government to build a Space Force military branch
- Evaluate efforts of other countries and governments to build capabilities for waging war in orbit and outer space (Australia, China, Russia, Japan, France, others)
- Assess fallout of conflicts in space such as the creation of debris and the challenges of clean-up
- Examine the use of robots in space for both conflict and peaceful (exploration) purposes
- Describe what rules and laws will be most important to prevent future conflicts and wars in space

Module 9. Spacecraft Technology

Since the first spacecraft, the V2 rocket, was launched by Germany in 1944, humankind has continued to launch objects beyond Earth's atmosphere. This has included satellites, robots, a car, and even some Legos. But there is a giant leap in difficulty when we talk about sending living beings into outer space with the expectation that they'll survive the trip. Human life is even more fragile in space so ensuring the survival of astronauts as they travel in and out of the Earth's atmosphere or settle on a celestial body or permanent spacecraft is not an easy feat.

In this module, you'll learn about what makes this possible. Spacecraft technology is evolving at a very rapid pace not only to send robots and probes where humans can't go yet but also to help humans survive at tremendous speeds, extreme temperatures, and deadly radiation. You'll also get a preview of what is on the horizon of spacecraft design and will allow us to go farther and farther from our home planet.

***Learning Objectives*:** In this module, students will:

- Describe the difficulties of human space travel that must be addressed in spacecraft design
- List the subsystems of spacecraft and define the function of each one
- Summarize the technology and science that enable rocket propulsion and spacecraft re-entry
- Examine the risks, costs, and potential of reusable rockets
- Compare historical and current spacecraft with possible future designs that may support interplanetary and interstellar travel
- Evaluate a day in the life of an astronaut on a spacecraft or space station, describing elements of the spacecraft that allow humans to survive and work

Module 10. Interstellar Travel

The stars in the night sky sometimes look so close you can almost reach out and grab them. But with today's technology and speed limits, it would take hundreds or thousands of human lifetimes to reach even the closest star. But that has not stopped humankind from dreaming, inventing, and writing about the possibilities of interstellar travel. Students will learn need-to-know terms such as astronomical units, light speed, exoplanet, propulsion, and g-force. Then it will describe theories of achieving interstellar travel, including the feasibility of an interstellar mission. This module will explore the limits of the galaxy and universe; the very edges of technology, physics, and science.

***Learning Objectives*:** In this module, students will:

- Identify the reasons and motivations behind interstellar travel
- Define astronomical units, lightyear, propulsion, and gravity units
- Examine the discovery of exoplanets and their possibility of supporting life
- Discuss the feasibility of an interstellar mission given energy requirements, distances, and risks
- Evaluate challenges to interstellar travel based on today's technologies
- Describe theories for interstellar travel, citing ideas from physics and science fiction