Exploring Exoplanets with Python
AWS Spark | Student Unit

Unit description
The Exploring Exoplanets with Python unit is supplemental STEM and CTE content for educators to incorporate into their classroom curricula. In the role of a Junior Researcher studying exobiology, students will have the opportunity to interact with data sets focused on three key aspects of planetary habitability: temperature, crustal composition, and atmospheric pressure. Learners will explore these sets via Amazon SageMaker Studio notebooks to run and edit sample code written in Python. Hands-on simulations and lab experiences help students connect their learning with real-world applications to show how programming, statistics, and data presentation can help automate tasks in data science, while allowing unique insights into large data sets.

Learning modalities in Exploring Exoplanets include multimedia presentations, vocabulary practice, simulation activities, and hands-on labs.

Intended audience
This unit is intended for students and educators:

**Students:**
- At least 13 years of age
- Enrolled in secondary STEM and/or CTE classes in the US, UK, Canada, Israel, Singapore, and New Zealand

**Educators:**
- Teach STEM and CTE classes to secondary students aged 13 and older in the US, UK, Canada, Israel, Singapore, and New Zealand
- Interested in supplemental content to include in their curricula

Recommended subject integration
The Exploring Exoplanets unit is recommended, but not limited to, the following US subjects:

- Computer Science
- AP Computer Science A
- AP Computer Science Principles
- Data Modeling
- Business Math
- Computer Programming
- CTE Business Analytics
- Fundamentals of Information Technology
- Principles of Technology

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1 Science, Technology, Engineering, Mathematics (STEM)
2 Career and Technical Education (CTE)

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Recommended delivery method
This unit is designed to be facilitated by an educator in a classroom setting. The unit may also be delivered in a virtual or “flipped classroom” manner with minimal educator instruction, if desired. A detailed Instructor Guide accompanies the unit to assist educators with synchronous or asynchronous facilitation.

Standards alignment
This unit aligns with the following US-based standards:

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<thead>
<tr>
<th>Computer Science Teacher Association (CSTA) K-12 CS Standards³</th>
<th>Details</th>
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<tbody>
<tr>
<td>3A-AP-18</td>
<td>Create artifacts by using procedures within a program, combinations of data and procedures, or independent but interrelated programs.</td>
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<tr>
<td>3A-DA-11</td>
<td>Create interactive data visualizations using software tools to help others better understand real-world phenomena.</td>
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<tr>
<td>3A-AP-13</td>
<td>Create prototypes that use algorithms to solve computational problems by leveraging prior student knowledge and personal interests.</td>
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<table>
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<tr>
<th>Common Core (CCSS)⁴ K-12 Standards</th>
<th>Details</th>
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<tbody>
<tr>
<td>HSS.MD.A.1</td>
<td>Calculate expected values and use them to solve problems</td>
</tr>
<tr>
<td>HSS.MD.B.5</td>
<td>Use probability to evaluate the outcomes of decisions</td>
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<tr>
<td>HSA.REI.A.1</td>
<td>Understand solving equations as a process of reasoning and explain the reasoning</td>
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Prerequisites
We recommend the following prerequisites for students and educators:

**Students:**
- Completed *Introduction to the AWS Cloud and Sustainability* unit

**Educators:**
- Completed *Introduction to the AWS Cloud for K-12 Educators* training
- Reviewed the Instructor Guide for *Exploring Exoplanets with Python* unit
- Comfortable explaining entry-level math and computational concepts to 13+ year old students

Technical requirements
Educators and students must have:
- Access to a Windows or Mac laptop, or a Chromebook.
- Access to an internet connection

³ https://www.csteachers.org/Page/standards
Unit and module objectives

In this unit, students will:

• Identify the key factors in determining potential habitability for a planet
• Explain a strategy for calculating the temperature of a planet
• Recognize the importance of algorithms to automate difficult or repetitive tasks
• Use basic mathematical and statistical concepts to complete introductory programming tasks in Python
• Describe key roles and responsibilities on professional data science teams
• Use Amazon SageMaker Studio notebooks to conduct exploratory data analysis and create data visualizations
• Practice using data visualization techniques to support a conclusion

This unit features three modules, where students will learn and recognize:

Module 0: Getting Started

Objectives

• Recall key terms used in exobiology
• Recall key terms used in computer programming and data science
• Learn to navigate unit content

Module 1 and 2: Looking for Life with SageMaker Studio Notebooks

Objectives

• Identify the key factors in determining potential habitability for a planet
• Explain a strategy for calculating the temperature of a planet
• Recognize the importance of algorithms to automate difficult or repetitive tasks
• Use basic mathematical and statistical concepts to complete introductory programming tasks in Python
• Use Amazon SageMaker Studio notebooks to conduct exploratory data analysis

Unit outline

Module 0: Getting Started

• Carousel Presentation: Navigating This Unit
• Interactive Glossary: Key terms with images, broken into exobiology, data science, and programming

Module 1: Looking for Life with SageMaker Studio Notebooks, part 1 (45 minutes)

• Multimedia Presentation: Mission Briefing
• Multimedia Presentation: Mission Training
• Multimedia Presentation: Using Algorithms
• Interactive Simulation in Python: Talking to Computers
• Interactive Simulation in Amazon SageMaker Studio: Programming Basics
• Knowledge Check

Module 2: Looking for Life with SageMaker Studio Notebooks, part 2 (45 minutes)

• Multimedia Presentation: Meeting Your Team
• Multimedia Presentation: Meeting Your Tools
• Multimedia Presentation: Tips, Tricks, and Troubleshooting for Amazon SageMaker Studio notebooks
• **Hands-on Lab**: Using Amazon SageMaker Studio Notebooks to Conduct Exploratory Data Analysis and Create Visualizations
• Knowledge Check
• Next Steps: How can you continue to study exoplanets? How can you continue to develop your data analysis skills?