Cancer Hunters in the Cloud
AWS Spark | Student Unit

Unit description
The Cancer Hunters in the Cloud unit introduces students to the ways in which researchers use the cloud to uncover mutations that may cause cancer. Students will begin to understand the vital role cloud computing plays in creating personalized treatment plans for specific mutations, while learning key concepts of bioinformatics and exploring the steps of cancer research. The intermediate-level unit is designed as supplemental STEM⁠¹ and CTE⁠² content for educators to incorporate into their classroom curriculum.

The 90-minute unit is broken into two 45-minute modules of presentations, guided demo simulations, and hands-on labs activities using Amazon Simple Storage Service (Amazon S3), Amazon Elastic Compute Cloud (Amazon EC2), and Amazon Athena.

Intended audience
This unit is intended for students and educators:

**Students:**
- At least 13 years or older
- Enrolled in participating AWS Spark secondary school STEM and/or CTE classes

**Educators:**
- Teach STEM and/or CTE classes to eligible secondary school students at a participating AWS Spark school
- Interested in supplemental curricular content designed to highlight the ways in which cloud computing technology is used in the subjects they teach

Recommended delivery method
This unit is designed to be facilitated by an educator in a classroom setting. If necessary, the unit may be delivered in a virtual or “flipped classroom” manner with minimal educator instruction.

Prerequisites
We recommend the following prerequisites for students and educators:

**Students:**

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

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• Completed Introduction to the AWS Cloud and Sustainability unit
• A basic understanding of the role of DNA in cell division and growth
• A basic understanding of how mutations may lead to cancer
• Experience with the cell cycle including G1, S, G2, and M stages and cell cycle regulators

**Educators:**
• Completed Introduction to the AWS Cloud for K-12 Educators training
• Reviewed and completed the Instructor Guide for Cancer Hunters in the Cloud unit
• Experience explaining genetics concepts to secondary school students
• Scaffolding that is sensitive to students as most are directly or indirectly impacted by cancer
• A basic understanding of how big data is being used in biomedicine (bioinformatics)

**Technical requirements**

Educators and students must have:
• Access to a laptop or desktop computer running Windows, Mac or Linux, or a Chromebook
• Access to internet connection
• Access to the following sites prior to teaching the unit: (Educators should ask the school district’s Network Administrator for assistance.)
  o labs.vocareum.com
  o labs.vocareum.com.cdn.cloudflare.net
  o proxy*.vocareum.com
  o proxy*.vocareum.com.cdn.cloudflare.net
  o *.aws.amazon.com

**Unit and module objectives**

In the Cancer Hunters in the Cloud unit, students will:
• Investigate the ways in which the AWS Cloud and big data have led to advances in genetic sequencing and personalized medicine
• Explore using Amazon S3 for data storage and Amazon EC2 computing in cancer-cure research
• Analyze genomic data sets using SQL in Amazon Athena
• Apply scientific research process to detecting and matching patterns within data sets

This unit features two modules, where students should learn and recognize:

<table>
<thead>
<tr>
<th>Module 1: Introduction to genetic research and data storage in the AWS Cloud</th>
<th>Module 2: Discovery of cancer cell mutation and treatment</th>
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<tr>
<td>• Investigate the role of AWS Cloud computing and big data in genetic sequencing, especially relating to cancer treatment research.</td>
<td>• Differentiate cancer cells from normal cells due to mutations</td>
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<tr>
<td>• Explore how to use Amazon S3 to store large sets of biological and genetic data.</td>
<td>• Recognize the role of bioinformatics in cancer detection.</td>
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Unit outline

Module 1: Introduction to genetic research and data storage in the AWS Cloud (45 minutes)
- Introduction of biology and genetics research
- Introduction of AWS data storage and cloud computing
- Overview of Amazon S3, genomic research, and types of cancer-causing cell mutations
- Simulation demo: Explore Amazon S3
- Introduction of DNA sequencing and cancer detection
- Overview of cancer treatment research using Amazon EC2
- Overview of Amazon Athena
- Overview of the national cancer data set and key indicators from the data set
- Simulation demo: Explore Amazon Athena

Module 2: Discovery of cancer cell mutation and treatment (45 minutes)
- Overview of bioinformatics
- Introduction to discovering cancerous cell mutation and identifying therapy treatment
- Hands-on lab: Cancer hunters in the cloud