IGNITE MY FUTURE

LESSON TITLE

Astronaut, Musician, or President?

Guiding Question: Is Life Fair?

Ignite Curiosity

- Did you know that U.S. presidents and other world leaders are usually tall? Why might this be the case?
- Are musical "geniuses" born or formed by their environment? Why do you think so?
- Why might a baseball coach try to teach a promising pitcher to pitch left-handed?

What makes someone good at what they do? Is it nature, nurture, or both that influence our success? In his bestselling book *Outliers*, Malcolm Gladwell makes the case that at least some of our success comes from our genetic makeup. Are some careers out of reach for certain people because of their physical traits? How can thinking like computers help us overcome or compensate for physical limitations that prohibit or hinder us from pursuing our passions? In this lesson, students will use the computational thinking strategies of finding patterns and developing algorithms to outline how a person who does not possess a certain genetic trait can become successful at a given skill. In **THINK**, students will discuss how the Internet impacts their lives. students will collaborate to brainstorm specific careers that are associated with certain inherited traits. They will use these data to research and find patterns in **SOLVE**. Using the patterns they find and the examples of algorithms on the free Drawio website, they will **CREATE** an algorithm that demonstrates how these inborn characteristics can be overcome. In **CONNECT**, students will communicate and evaluate their algorithms and explore more about the careers they have researched.

Students will be able to:

- **Evaluate** the computational problem of traits that influence success,
- **Analyze** patterns to create rules and solve the problem, and
- **Create** algorithms to show where technology can make careers accessible to more people.

SUBJECTS

English/Language Arts
Social Studies
Science

COMPUTATIONAL THINKING PRACTICE

Recognizing and Defining Computational Problems

COMPUTATIONAL THINKING STRATEGIES

Find Patterns
Develop Algorithms

MATERIALS

Astronaut, Musician, or President research sheet

Flowchart Shapes student guide

Astronaut Flowchart Draft student guide

Computers with Internet access

Students will first brainstorm a list of inherited traits of a career group to research and attempt to answer the *why* behind these trends.

1 **Read** the following scenario to students:

Are some careers out of reach for some people because of their physical traits? Your team will think like a computer by brainstorming patterns of career groups to research and then writing an algorithm to find ways to make these careers accessible to more people.

2 **To begin,** organize students into teams and distribute copies of the Astronaut, Musician, or President research sheet to help them organize their thinking.

3 **Tell the students** that right now they will be completing only the first and second columns on the capture sheet: Career Group and Inherited Traits: Hypothesis.

4 **Then, kindle the students' brainstorming** activity by asking the following guiding questions. You can record students' responses on the board or in a central location.

- What are some career groups that seem to have genetic patterns that help people in these careers do their job?

- Which of these career groups could we research? We will need groups for which data have been recorded. For example: Could we research the body size of astronauts? (Tall, short, or all sizes?) What about world leaders? (Tall, short, with mobility or other physical limitations or not?) Baseball likes to keep statistics. What trends could you imagine for pitchers? (Right-handed, left-handed?) What about for catchers? (Short, tall?)

5 **Once a list of traits has been identified**, instruct students to research available data to illuminate patterns.

? Find more easy-to-implement resources to integrate computational thinking practices into your classroom by visiting **ignitemyfutureinschool.org**

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Students will work in teams using provided data sets to find patterns among various careers.

1 **Gather students** for a group discussion and tell them that next they will be attempting to answer the fourth column, Why?, on the Astronaut, Musician, or President research sheet.

2 **Tell** the students that they are hypothesizing possible answers that they will attempt to confirm in their research. Be mindful of social/cultural sensitivities.

3 **Discuss with the students:** *As you research today, you will be looking for genetic or inherited traits and not stereotypes. You will be attempting to confirm through research your hypotheses in the earlier section. You will also be attempting to answer **why** these traits make the careers easier or possible. Why do leaders tend to be tall? If more successful baseball pitchers seem to be right-handed (or left-handed), why? Why must astronauts be in a certain height range?*

4 **Once the students** have reasonable answers or thoughts for each career group, divide them into teams.

5 **Using the inherited characteristics and patterns** discovered in Think and recorded on the Astronaut, Musician, or President research sheet, each team will choose a career to research. Some examples of possible career groups associated with genetic traits include the following:

- **Baseball pitchers:** why it is advantageous to be left-handed
- **Astronauts:** physical requirements for astronauts
- **World leaders who are tall:**
  http://www.macleans.ca/politics/washington/looking-up-to-leadership-do-you-have-to-be-tall-to-be-u-s-president/
- **Absolute pitch:** The idea that musicians must be able to recognize notes by their names:
  http://deutsch.ucsd.edu/psychology/pages.php?i=215
  https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3596158/
  http://deutsch.ucsd.edu/pdf/MP-2004-21_339-356.pdf

  Allow students to add data sets that they find and would like to research.

6 **Students should record the data** they find in the Inherited Traits: Facts from Research column on their Astronaut, President, or Musician research sheet.

7 **As an extension**, students could research efforts to channel persons with physical disabilities into competitive employment and leadership positions through the University of Delaware's National Leadership Consortium on Developmental Disabilities and other associations.

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Students will sort the patterns and organize these data to construct an algorithm for their career group. Then, they will identify a spot in the algorithm where technology could make the career accessible to more people and modify their algorithm to include that technology.

1 **Gather** the students again for a group discussion and allow them to share the research and patterns they have collected.

2 **Tell** students that next they will be attempting to solve the problem of career limitations and make life fairer. Read the following to the students: *Are there ways to enable more people to be successful in a chosen career field? For example, if a person is right-handed, how can he or she still become a successful pitcher? If a person is short, how could he or she become an astronaut? If a person has poor vision, how could he or she become a pilot?*

3 **Show** students the Astronaut Flowchart Draft and the Flowchart Shapes worksheet.

4 **Explain to students** how the different shapes describe the steps in the pattern of an algorithm.

5 **Emphasize** to students that the algorithm needs to be a closed loop.

6 **Then, divide the students** into pairs and have them explore the Drawio website to learn more about algorithms.
- Access https://www.draw.io/.
- Select where to save your diagram (Google, Dropbox, Device).
- Create a new blank diagram document or use a template.
- Click the blue Create button at the bottom-right side of the screen to begin.

7 **Using the information** they have learned and the facts and patterns they have found, each pair will write an algorithm on the Drawio website for its assigned career group.

8 **Remind the students** to save their diagram.

9 **Next**, ask each pair to identify a spot in the algorithm where technology could make the career accessible to more people. If airplane pilots and astronauts needed to be tall to fit into a standard seat, are there adjustments that could be made to the seats without compromising safety? What other compensations could be made to overcome the patterns and trends studied in this lesson?

10 **Examples include the following:**
- A surgery that could correct red-green colorblindness for pilots
- Developing new seats or cockpits for astronauts
- Creating a machine or biomedical apparatus that will help firefighters carry heavy weights
- Inventing an app to increase musical technique for those who do not have absolute pitch

10 **Have the student pairs trade their algorithm** with another student pair and ask them to evaluate and make suggestions for improvement.

11 **If students do not have Internet access**, they may manipulate the shapes in Word using the Flowchart Shapes Student Handout. Alternately, they may draw the shapes using pencil and paper for an analog/historical version of this activity.

Select one of the strategies listed below to help students answer these questions:

- **How do this problem and solution connect to me?**
- **How do this problem and solution connect to real-world careers?**
- **How do this problem and solution connect to our world?**

1 **Write** the three questions on PowerPoint or flip chart slides and invite students to share out responses.

2 **Display** pieces of chart paper around the room, each with one question written on it. Ask students to write down their ideas related to the questions on each sheet.

3 **Assign** one of the questions to three different student groups to brainstorm or research, and then share out responses.

4 **Invite** students to write down responses to each question on a sticky note, and collect them to create an affinity diagram of ideas.

How does this connect to students?

By the end of this lesson, students will have learned many details about patterns in careers. They will have explored ways to overcome genetic advantages or perceived genetic advantages. They will also have experienced the benefit of working in teams, finding patterns, and breaking down tasks into steps, all of which make any daily task or job easier.

How does this connect to careers?

Aerospace Engineers design, construct, and test aircraft, missiles, and spacecraft. These engineers consider the physical requirements for pilots and others who operate aircraft and spacecraft. In their designs, they must balance safety with the goal of making careers accessible to as many qualified people as possible.

Biomedical Engineers combine engineering principles with medical and biological sciences to design and create equipment, devices, computer systems, and software used in healthcare. These are examples of technology that can help make careers such as those studied in the lesson accessible to more people.

Coaches and Trainers teach amateur and professional athletes the skills they need to succeed at their sport. They help players make the most of their skills and improve in areas where they are not naturally skilled.

Sociologists study society and social behavior by examining the groups, cultures, organizations, social institutions, and processes that develop when people interact and work together.

How does this connect to our world?

Students may think that because of their physical or genetic makeup, certain career pathways are closed to them. In today's increasingly technological environment, the range of careers reserved for those who have inherited specific genetic traits is narrower every day. Through finding patterns and writing an algorithm, students will learn that computer thinking can open many previously closed career pathways and can also help life seem fairer.

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National Standards

NEXT GENERATION SCIENCE STANDARDS

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in 6–8 builds on K–5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories. ▪ Construct an explanation that includes qualitative or quantitative relationships between variables that describe phenomena. **Developing and Using Models** Develop a model to generate data to test ideas about designed systems, including those representing inputs and outputs. (MS-ETS1-4).	**LS3.A: Inheritance of Traits** Genes are located in the chromosomes of cells, with each chromosome pair containing two variants of each of many distinct genes. Each distinct gene chiefly controls the production of specific proteins, which in turn affects the traits of the individual. Changes (mutations) to genes can result in changes to proteins, which can affect the structures and functions of the organism and thereby change traits. (MS-LS3-1) Variations of inherited traits between parent and offspring arise from genetic differences that result from the subset of chromosomes (and therefore genes) inherited. (MS-LS3-2)	**Structure and Function** Complex and microscopic structures and systems can be visualized, modeled, and used to describe how their function depends on the shapes, composition, and relationships among its parts, therefore complex natural structures/systems can be analyzed to determine how they function. (MS-LS3-1)

COMMON CORE STATE STANDARDS CONNECTIONS

CCSS.ELA-LITERACY.W.8.2
Write informative/explanatory texts to examine a topic and convey ideas, concepts, and information through the selection, organization, and analysis of relevant content.

CCSS.ELA-LITERACY.W.8.7
Conduct short research projects to answer a question (including a self-generated question), drawing on several sources and generating additional related, focused questions that allow for multiple avenues of exploration.

CCSS.ELA-LITERACY.W.8.8
Gather relevant information from multiple print and digital sources, using search terms effectively; assess the credibility and accuracy of each source; and quote or paraphrase the data and conclusions of others while avoiding plagiarism and following a standard format for citation.

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National Standards

D2.His.14.6-8.
Explain multiple causes and effects of events and developments in the past.

D2.His.15.6-8.
Evaluate the relative influence of various causes of events and developments in the past.

K-12 COMPUTER SCIENCE FRAMEWORK

Practice 2. Collaborating Around Computing
Collaborative computing is the process of performing a computational task by working in pairs and on teams. Because it involves asking for the contributions and feedback of others, effective collaboration can lead to better outcomes than working independently. Collaboration requires individuals to navigate and incorporate diverse perspectives, conflicting ideas, disparate skills, and distinct personalities. Students should use collaborative tools to effectively work together and to create complex artifacts.

Practice 3. Recognizing and Defining Computational Problems
The ability to recognize appropriate and worthwhile opportunities to apply computation is a skill that develops over time and is central to computing. Solving a problem with a computational approach requires defining the problem, breaking it down into parts, and evaluating each part to determine whether a computational solution is appropriate.

Practice 4. Developing and Using Abstractions
Abstractions are formed by identifying patterns and extracting common features from specific examples to create generalizations. Using generalized solutions and parts of solutions designed for broad reuse simplifies the development process by managing complexity.

Practice 5. Creating Computational Artifacts
The process of developing computational artifacts embraces both creative expression and the exploration of ideas to create prototypes and solve computational problems. Students create artifacts that are personally relevant or beneficial to their community and beyond. Computational artifacts can be created by combining and modifying existing artifacts or by developing new artifacts. Examples of computational artifacts include programs, simulations, visualizations, digital animations, robotic systems, and apps.

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Astronaut, Musician, or President Research Sheet

| Career Group	Inherited Trait Hypothesis	Inherited Trait Facts from Research	Why?
Astronaut	Tall	Between 5'2" and 6'2"	Needs to fit in seat and reach controls.
President	Tall	Tall	Shows a good leader?

Flowchart Shapes

Algorithms can be represented by shapes to show the steps involved.

1 Flowcharts use arrows to show the direction that the steps move.

2 A decision loop is the part of the algorithm where a question is answered and the path divides. Typically, there is a "yes" or "no" question, and the path may circle around until the answer is "yes" or terminate in a "no" result.
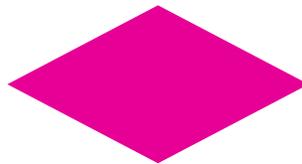
3 The beginning and the end of the algorithm are marked with a special shape. All paths begin at the beginning and must terminate at the end.

4 The result is what happens after answering the question at the decision loop.

5 The output is the resolution of the result and what would be printed on the screen in the case of a computer algorithm.

6 A decision is where the path divides but does not loop.

Astronaut Flowchart Draft

Astronauts must be between 5 feet, 2 inches and 6 feet, 2 inches tall to reach the controls. They must also have perfect vision (20/20).