



SOLUTION SEEKER ACTIVITY

Maintenance and Medicine

LEARNING OBJECTIVES

Students will:

- *Analyze* how preventive measures help to stave off problems in both mechanical maintenance and public health
- *Evaluate* the similarities and differences between careers in mechanical maintenance and health care
- *Create* a diagnostic tool that applies problem-solving approaches used in mechanical maintenance to diagnosing and treating COVID-19

OVERARCHING QUESTION:

Can we fix public health like we fix machines?

STANDARDS:

Next Generation Science Standards

- Engineering Design
 - 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.

C3 Framework for Social Studies Standards

- D4.3.6-8. Present adaptations of arguments and explanations on topics of interest to others to reach audiences and venues outside the classroom using print and oral technologies (e.g., posters, essays, letters, debates, speeches, reports, and maps) and digital technologies (e.g., Internet, social media, and digital documentary).

Common Core English Language Arts

- Writing:
 - CCSS.ELA-LITERACY.WHST.6-8.2: Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes.
- Reading:
 - CCSS.ELA-LITERACY.RI.8.7: Evaluate the advantages and disadvantages of using different mediums (e.g., print or digital text, video, multimedia) to present a particular topic or idea.

Instructional Note:

The following activity has been designed so you can tailor it to your current mode of instruction.

- The *Introduce*, *View & Reflect*, and *Conclude* sections can be presented virtually, by video, or through a shared document.
- The *Challenge* section is designed for students to complete independently at home. Students can either complete their diagnostic tool on paper or by using online applications such as **Google Docs** or **SketchUp**.

ACTIVITY OVERVIEW:**Introduce**

- Begin by introducing students to the general concept of maintenance.
 - Ask students to give examples of “maintenance”. The question should be intentionally broad so that students can provide diverse examples. Responses may include servicing a car, doing software updates on your computer, doing the work that building maintenance professionals do, etc.
 - Define maintenance as the process of care and upkeep — that means that maintenance includes taking good care of something both before and after it breaks.
 - Explain that there are four main types of maintenance¹:
 - Reactive maintenance: fixing something once it has broken
 - Preventive maintenance: scheduled check-ups and repairs meant to prevent something from breaking
 - Predictive maintenance: measuring that predicts when a repair is needed or a problem is likely to happen
 - Reliability-centered maintenance: a type of analysis that determines what type of maintenance is best for each need
 - Many organizations, including the U.S. Department of Energy, view maintenance as a core element of successful manufacturing. The other elements include operations, engineering, administration, and training.²

1 https://www1.eere.energy.gov/femp/pdfs/OM_5.pdf

2 <https://silo.tips/download/chapter-3-om-management>

- Make connections between the fields of manufacturing and healthcare by sharing the following with students:
 - Much like preventive maintenance prevents machinery in a factory from breaking, preventive medicine focuses on keeping people and communities healthy to avoid illness.³
 - We can think about doctors as maintenance professionals who perform the four types of maintenance with patients:
 - Reactive: helping us when we are sick
 - Preventive: encouraging us to develop good and healthy habits, like exercising and eating right, to avoid disease
 - Predictive: ordering diagnostic tests that can help us see if we are at risk for health issues down the road
 - Reliability-centered maintenance: when we visit the doctor and tell them our symptoms, they determine which methods—reactive, predictive and/or preventive—to use in order to help us achieve optimal health
- Draw the chart below in a centrally viewable location. This might be on a chalkboard or a shared document.

Reactive	Preventive	Predictive	Reliability-Centered

- Divide students into groups of four. Assign each group one type of maintenance. Direct groups to think of as many examples of how their type of maintenance appears in healthcare as they can. Provide groups with approximately 5 minutes to brainstorm ideas. When they have finished, invite one representative from each group to input the group's answers into the chart and explain their examples.
 - Some examples might include the following:
 - Reactive: your doctor prescribes you medicine for strep throat
 - Preventive: your dentist tells you to brush your teeth twice a day to prevent cavities
 - Predictive: your doctor orders genetic testing to see if you are at risk for developing cancer later in life
 - Reliability-centered: you complain to your doctor about chest pain and they ask questions to determine the best course of action
- Explain that students are about to watch a short video that highlights how one company—GAF—hires maintenance electricians that practice preventive, predictive, reactive and reliability-centered maintenance. The video will feature an interview with a maintenance electrician named Tyler, who will talk about how he maintains huge machines that are essential to keeping GAF's business running.

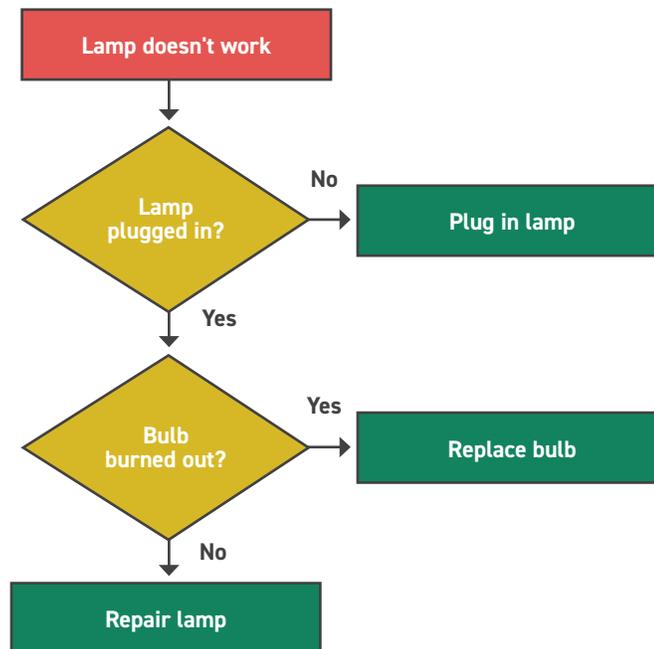
³ <https://www.acpm.org/about-acpm/what-is-preventive-medicine/>

View & Reflect

- After they have watched the GAF video, provide students with the **Careers in Maintenance and Medicine** capture sheet. Explain that students will investigate similarities and differences between two careers: electricians and physicians.
- Inform students that you will play the video one more time. As the video plays, they will record any relevant information in the “Electrician” side of the capture sheet.
- When the video has finished playing, provide students with the following links (you can either direct students to visit these links on Internet-enabled devices or print out one copy of each career profile to hand out to each student:
 - **U.S. Bureau of Labor Statistics Career Profile: Electricians**
 - **U.S. Bureau of Labor Statistics Career Profile: Physicians and Surgeons**
- Working individually, students will go on a scavenger hunt by using the career profiles to fill in the remaining spaces on their capture sheets.
- When students have completed their capture sheets, summarize the activity by asking students to respond to the following critical thinking questions:
 - What was similar in the two career profiles you explored? What was different?
 - Why do you think that the pay for physicians and surgeons is higher than the pay for electricians?
 - Why do you think that the demand for electricians is predicted to be twice as high as the demand for physicians and surgeons in the future?
 - Electricians and healthcare professionals are both considered essential workers during the COVID-19 pandemic. Why do you think that is?

CHALLENGE

- Introduce students to the concept of diagnostic tools. Explain that diagnostic tools are tools that we use to identify problems that need treatment. Diagnostic tools include computers, surveys, medical devices, etc. One type of diagnostic tool that can help professionals determine the appropriate course of action is a flowchart. Flowcharts are visual tools that design and document processes. Explain that flowcharts are often used by mechanical engineers to troubleshoot and fix machines.
- Show students the following flowchart⁴.



- Highlight the following important elements of the flowchart:
 - Flowline:
 - 
 - Shows the order of operation/directs the user where to go next
 - Decision:
 - 
 - Represents a decision point, like a yes/no
 - Terminal:
 - 
 - Means the end of the process

⁴ <https://en.wikipedia.org/wiki/Flowchart#/media/File:LampFlowchart.svg>

- Using paper/pencil or an online application, direct students to create an example of a flowchart a doctor could use to diagnose a patient with COVID-19. Instruct students to use the following resources to build their chart:
 - [The CDC's Symptoms of Coronavirus list](#)
 - [ZenFlowchart for instructions on how to create a flowchart](#)
- Direct students to build their flowcharts independently.
- When students have completed their flowcharts, instruct them to pair off and work with their partner to revise their design.

CONCLUDE

- Once the *Challenge* activity is complete, invite students to share their flowcharts and revision ideas with the class.
- Encourage students to compare and contrast the solutions they developed and consider how they could optimize their solutions based on the ideas of their peers.
- Wrap up by encouraging students to keep the flowchart in mind as a problem-solving tool. It has many applications, in STEM and beyond!

Careers in Maintenance and Medicine

	Electricians	Physicians and Surgeons
What do they do?		
Where do they work?		
How much do they earn?		
What kind of training do they need?		
What skills do you need to do the job?		
Is there demand for this profession? If so, how much?		
List some similar careers		