NATURE 2017

Advanced Manufacturing

Description

Students will be learning about advanced manufacturing and what makes it different from the past. They will have the chance to design their own prototype and test it. Finally they will learn how to sketch a model, create it in computer based program that will allow them to 3D print the product when finished.

Objectives

* Technology helps humans solve practical problems.
* Advanced manufacturers rely on cutting edge technologies.
* Different technologies have benefits and tradeoffs.
* Many factors influence how products are manufactured.
* Design and create prototypes

Schedules

9:00 am – 9:30 am Cultural Presentation

9:30 am – 10:15 am Power Point

10:15 am – 10:30 am Break

10:30 am – 11:30 pm Activity 1

11:30 am - 12:00 pm Activity 2

12:00 pm – 12:30 pm Lunch

12:30 pm – 1:30 pm Cont. Activity 2

1:30 pm – 2:45 pm Activity 3

2:45 pm – 3:00 pm Wrap-up

Activity 1

Modern Manufacturing: Do You Have What It Makes?

Summary:

In this activity you will work through an interactive self-paced module designed to help students learn about advanced manufacturing. In this module, students discover that advanced manufacturers work in teams to solve complex problems that improve processes, products, and people’s lives. Students will investigate the applications of 3D printing, robotics, and computers, and consider how each of these technologies help manufacturers solve practical problems. Along the way, students will discover the relationship between advanced manufacturing careers and the products they build that shape the world. This student interactive module is designed to take approximately 40 minutes to complete.

Materials:

1. Computer

Procedure:

This module is designed to be flexible to meet the needs of many different learning environments.

1. We will discuss 3 pre-module questions.
2. We will discuss a topic.
3. Do the module for that topic.

<http://www.manufactureyourfuture.com/sites/manufactureyourfuture.com/files/modern-manufacturing/#/>

1. Answer the questions for that topic
2. Repeat for until all topics are discussed
3. Assess the students learning with a post-test.

Key Vocabulary

|  |  |
| --- | --- |
| Advanced Manufacturing | The use of technology to improve products and processes. |
| Computer-Aided Design | The use of computers to optimize designs. |
| 3-D Printers | A tool that builds up three-dimensional objects one layer at a time using plastics, metals, synthetics, food, and ceramics. |
| Robotics | A branch of technology that deals with the design, construction, operation, and application of robots. |

Pre-module questions

1. What are three things that come to mind when you hear the word manufacturing?
2. What factors influence changes in advanced manufacturing?
3. What types of technologies are used in advanced manufacturing?

Discussion

Consider pausing at the end of each module topic to pose questions to students. Suggested questions and prompts are provided below.

Topic 1

Advanced manufacturing allows us to create products that solve complex problems. The first topic of the module teaches students about the types of products advanced manufacturers create. Advanced manufacturers design and innovate products and processes that impact all of our lives. These innovations are most likely inspired by a problem to solve. Problems may come from solving an inconvenience people have or an inefficiency in everyday processes. Problem-solving is critical when working in advanced manufacturing environments. In order for advanced manufacturers to create a successful product, it needs to solve a problem. Advanced manufacturers work to make things more efficient and cheaper.

Question #1

What problems have you seen in your school or community that could be solved through engineering? Think of some challenges that you see around you, that you would like to solve.

Possible answers: How to reduce food waste, how to grow food or raise chickens in an urban environment, or a way to save space when storing bikes or skateboards at school.

Question #2

Engineers and scientists likely start with a problem or question they are interested in solving. What are ways you can discover potential problems?

Possible answers: immerse yourself in a situation to find missed opportunities, make observations, or interview people to share about challenges they face.

Question # 3

What are experiences you have that are relevant to engineering?

Possible answers: Household examples could include identifying and solving problems when cleaning or when something breaks, improving functionality in the home, reducing energy costs, or constructing furniture. Recreational examples could include playing video games related to design and using technology when exercising.

Topic 2

Advanced manufacturers work with cutting edge technologies. The next topic of the module invites students to explore how advanced manufacturing is always changing. Especially as technology continues to advance, manufacturing techniques improve product design and development. Technologies featured in this module include rapid prototyping, computers, and robotics. Rapid prototyping is an additive method in which parts are built layer by layer. One machine can produce any part that fits within its constraints and is appealing to advanced manufacturers in increasing automation, reliability, and reducing excess mass. Robots are machines that can be used alongside humans or instead of humans to do a job. Robotics can be programmed to complete tasks or controlled by a human. Advanced manufacturers use the strengths of both humans and robots to accomplish tasks. Finally, computers are used in product design and automation. They cover a wide scope of advanced manufacturing applications from computer-aided design to analyzing data.

Question #1

How could rapid prototyping be used during extended space travel?

Possible answers: Repair broken items, create new designs, create custom parts, and solve unexpected challenges.

Questions #2

Identify a technology that has evolved over time. What do you think may have influenced the changes?

Possible answers: Cell phones, cars, or headphones.

Topic 3

Advanced manufacturing shapes our world. The final topic of the module shows students how advanced manufacturers enable us to have the exciting products we use every day and prepare for innovations of the future. The work of advanced manufacturers influences our lives every day. They help design and develop innovations that would be difficult to live without. Products designed and made by advanced manufacturers both influence and are influenced by society. They can cause cultural, social, economic, and political changes as well as provide safety and comfort.

Question #1

Unmanned Aerial Vehicles, commonly known as drones, are essentially a flying robot. Drones can carry film cameras high in the sky for a wide range of shots and can deliver aid to difficult to access areas. What are other examples of how drones could be used now or in the future?

Possible answers: Farming, archeology, delivering food and packages, and covering the news.

Question #2

A Maker Faire is an opportunity to showcase people who enjoy making things and their projects. What are different things you might do now, or are interested in making, that you could share?

Possible answers: Math art, hobbies, engineering challenges, robotics, and science experiments.

Post-Test

Question #1

Society’s role in the development and use of technology can best be described as \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

A. Influential. Society can drive the development and use of technology.

B. Stationary. Society does not impact development and use of technology.

C. Insignificant. Society has little impact development and use of technology.

D. Unproductive. Society does not provide any new ideas to impact development and use of technology

Question #2

Economic, political, and cultural issues are influenced by the development of products that advanced manufacturers make. Which of the following is an example of how society has influenced a product?

A. Poor audio quality on headphones led to the incorporation of noise cancellation technology.

B. Materials used for swimsuits in the Olympic Games gave athletes a competitive edge.

C. The camera was developed to document and preserve an image for a lifetime.

D. Portable solar chargers were created to supply electricity to small electronics.

Questions #3

Which of the following technologies is most likely used in advanced manufacturing to make a prototype or model?

A. Computers and 3D printers

B. Robotics and unmanned vehicles

C. Computers and Smartphones

D. Robotics and video cameras

Question #4

How would you describe the range of careers found in advanced manufacturing?

A. There are limited opportunities.

B. There are a variety of opportunities.

C. Most of the work is physically demanding.

D. Most of the work is completed in factories.

Activity 2

Balloon Powered Car design challenge

Apply the engineering design process to construct a prototype that meets certain specifications.

Summary:

Students construct racing cars from Foam blocks and power them with the thrust of an inflated balloon. In two-three racing trials per course, the racers shoot along three different courses, and the distance the racers travel is measured. Between trials, students redesign their racers to improve their performance and solve any “mechanical” problems that crop up. At the conclusion of the activity, students submit a report on their racer design and how it performed in the trials.

Materials

* Foam block
* Small plastic stirrer straws (round cross section) – 2 or more per racer depending on design
* Flexi-straws – 3 per racer
* 4- or 5-inch round balloon
* Cotton balls- representing boggy terrains
* Sand- representing beach or desert terrains
* Fish gravel- representing rocky terrain
* 3 extra-large foil baking pans
* Masking tape
* Sharp pencil
* Scissors (optional)
* Ruler
* Sand paper
* Measuring tape for distance traveled

Procedure

1. Watch the Curiosity Rover Landing video, group discuss the focus question

<https://search.yahoo.com/yhs/search?hspart=btbar&hsimp=yhs-002&type=br112dm1bs03&p=youtube%20mars%20rover%20landing%20video>

1. Distribute student handouts – Steps of the Engineering Design Process and Vocabulary words go over as a class
2. Break into groups and pick up the materials
3. Groups complete the Engineering Design Challenge

What balloon powered car design will travel successfully on different terrains?

1. Students Complete Lab Data sheets
2. Group share designs, communicate challenges and technical difficulties to the class.
   1. What step or steps of the engineering design process did your group have the most problems completing?
   2. What steps were the easiest?

Activity 3

Introduction to 3D printing- Design/Print a Board Game Piece

Students will be able to design, create, and print a game board piece based on their personality.

Materials

* Computer
* 3-D printer if available (not required)

Procedure

1. Play the video for the students of a time-lapse video of a 3D printer printing a bust of Yoda.
2. <https://www.youtube.com/watch?v=8_vloWVgf0o>
3. Watch a video of the ShowMe app

<https://www.youtube.com/watch?v=dUKv1S9Qoos>

1. The students will use the ShowMe app to start drawing their ideas.
2. Join the Tinkercad class, using the code provided by the teacher, and work through the tutorials or have them each sign in. Then click on features and then click on the tutorials

<https://projectignite.autodesk.com/>

1. Students will use Tinkercad to create a board game piece, no larger than 15 cm by 15 cm, based on their personality.
2. Once complete, students will save and share their creation with the teacher to print.
3. Students will present to their classmates their game piece and explain the basis for it.