

# iDigFossils

Engaging K-12 Students in Integrated STEM via 3D Digitization, Printing and Paleontology



**UF** | College of Education  
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## **Introduction to STEM**

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## LESSON TITLE

Introduction to STEM

## GRADE LEVEL

6th-8th grade

## TIME FRAME

Five 50-minute class period

## DRIVING QUESTION

What is STEM? How can we use technology to make our lives simpler, more productive, and more expansive?

## LEARNING GOALS

- Identify the benefits of 3D scanning and 3D printing
- Explain the general process of 3D scanning and 3D printing
- Make design decisions to create a dinosaur foot
- Identify a real world problem that could be solved using 3D printing
- Evaluate various STEM related careers and explain your findings

## ANCHORING EVENT

Begin the lesson by asking students the following discussion questions to activate prior knowledge.

- Have you ever seen a dinosaur in a museum?
- Are the bones of the dinosaur display real or fake? How do you know?
- How do scientists discover the fossils of a dinosaur?

Have students share their answers in their group tables. Then, have the students go on a virtual tour to a Museum in Moscow, Russia using the online resource at [www.nearpod.com](http://www.nearpod.com). Alternatively, have students watch the video How do scientists find fossils? After doing the anchoring activity students can discuss the following questions:

- Why museums may prefer fake bones over real bones.
- How do scientists discover the fossils of a dinosaur?

## COLLABORATIONS

In this lesson, students will collaborate in an online forum discussion using a digital resource like Canvas or Nearpod. If these tools are not available, students can collaborate by sharing their responses using a cooperative learning structure like Think-Pair-Share. Students will also work in small groups to share their responses to the suggested prompts at the beginning of the lesson. At the end of the lesson, students will collaborate as a whole class by sharing their ideas about STEM careers, and possible uses of 3D technology.

## STEM INTEGRATION

In this lesson, students will identify benefits for 3D printing and determine how to construct useful items that are inexpensive and useful for individuals. Students will also explore various STEM careers to understand the connection of the related fields. Students will describe the uses of the 3D printing technology. Students will participate in a fossil dig to find various fossil pieces, such as, coral, shells and shark teeth. Students will make at least one connection to mathematics identifying advantages and disadvantages of 3D printing technology (2D vs. 3D models) as well as making measurements of the fossils found in the fossil dig.

## RESOURCES

- Nearpod Lesson-3D Printing (free subscription to [www.nearpod.com](http://www.nearpod.com))
- What is 3D Printing? Article
- 3D Scanning Vocabulary
- 3D Printing Vocabulary
- 3D printing video

## ASSESSMENT

### Formative assessment

1. Quiz: True or False (can be done as part of the Nearpod presentation or as a traditional paper and pencil assessment)

- 3D printers only make items out of plastic. True or False
- 3D printing was invented in 2010. True or False
- 3D printing reduces the cost of making things. True or False
- A house can be built by a 3D printer. True or False

2. Prior Knowledge questions (see Anchoring Events)

### Summative assessments

#### 1. STEM Career discussion (see directions below)

In this assignment students will first investigate the following websites to learn about STEM careers. STEM careers are jobs that involve Science, Technology, Engineering and Mathematics.

#### Websites to explore:

- Women @NASA
- U.S. News-25 Best STEM jobs
- Optics Celebs

#### Students will then share with their peers the answers to the following questions:

- What career did you find the most interesting? Why?
- Currently, there are some programs that incorporate (combines) art with science, technology, engineering and math. Do you agree or disagree that it is important to incorporate arts in STEM related programs and jobs? Support your argument. You can add evidence from a reliable resource to support your argument. A suggested resource to explore the STEAM topic is <http://stemtosteam.org/> This discussion can be conducted using a learning management system, like Canvas, as a forum discussion or in small groups. If it is conducted in an online forum discussion students should respond to the responses of other peers by asking questions to their peers, sharing new websites related to STEM careers or by suggesting new ideas to your peers. Students are encouraged to use sentence starters like: "I agree and want to add...", "I respectfully disagree because..."

## Rubric for Communicating Information

Expert: 4	Proficient: 3	Approaching Proficiency: 2	Not Meeting: 1
<p>All the questions are answered and the ideas are communicated in a clear, coherent and detailed way and make connections to other topics learned in class, real life situations or other subject areas.</p>	<p>All the questions are answered and the ideas are communicated in a clear, coherent and detailed way.</p>	<p>Student responses are incomplete and the communication of ideas is not coherent or clear.</p>	<p>The responses are not related to the question.</p>

### 2. End of the lesson quiz

- 3D printers only make items out of plastic. True or False
- 3D printing was invented in 2010. True or False
- 3D printing reduces the cost of making things. True or False
- A house can be built by a 3D printer. True or False
- Definition: is a device that forces material, hot or cold through a die or template.
  - a. extruder
  - b. filament
  - c. functional prototype
  - d. 3D file

### 3. Application

Students will think of a problem they could solve using 3D printing. Then, students will draw a model of their design and explain how it would be used.

## **PROCEDURE**

### **DAY 1: ENGAGE**

On the first day the students will be engaged in the topic of paleontology and 3D technology by completing the anchoring activity as described above.

### **EXPLORE**

After completing the anchoring activity, students will be divided into two groups: one group of about 12 students will be observing the process of 3D printing while the other group (about 12 students) will be observing the process of 3D scanning. While observing these two processes, students can be asked to interact with the vocabulary related to 3D printing and 3D scanning (included below in the section Key/Academic Language). If students have access to a computer, the vocabulary can also be accessed on the following online public resources:

- 3D Printing Vocabulary
- 3D Scanning Vocabulary

### **DAY 2: EXPLORE**

On day students will complete the lesson available on [www.nearpod.com](http://www.nearpod.com) about 3D printing. Students will learn the benefits of 3D printing, illustrate the step by step process of 3D printing, analyze data of dinosaur fossil, and identify a real world problem that can be solved using 3D printing (see attached pdf version).

### **DAY 3: EXPLORE**

On Day 3 students will complete the STEM career discussion as described in the assessment section above.

### **DAY 4: EXPLORE**

On day 4 students will complete the following table after exploring a matrix with various fossil types from a Florida location.

Fossil	Visual Representation	Fossil Measurement (cm)
1		
2		
3		

### **EXPLAIN**

On day 4 students will also complete a graphic organizer to discuss the advantages and disadvantages of 3D technology.

## Graphic Organizer

Advantages	Disadvantages

### DAY 5: EVALUATE

#### GALLERY WALK

On Day 5 each student will present their models of a problem that could be solved using 3D printing from their Nearpod lesson. Students may draw their models on their computers using Nearpod or they can make a small poster. Students will do a Gallery Walk (see procedure above) to share their models. The teacher can set the computers or posters on the outside perimeter of the classroom. Students will have two minutes to add positive feedback and comments to each model using sticky notes. To facilitate the transitions the teacher can play some music.

## NEXT GENERATION SCIENCE STANDARDS (NGSS)

MS-ETS1-3: Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success.

The materials and activities outlined in this lesson plan are just a step towards reaching the performance expectation listed above.

Science Practices	Connection to the Lesson
Constructing explanations and designing solutions	
Disciplinary Core Ideas	Connection to the Lesson
ESS3.C-Human Impacts on Earth Systems ETS1.B-Developing possible solutions	
Crosscutting Concepts	Connection to the Lesson
Patterns	

## ISTE STANDARDS

Student Standard	Description
1. Creativity and innovation	Students use models and simulations to explore complex systems and issues.
2. Communication and collaboration	Students interact, collaborate, and publish with peers, experts, or others employing a variety of digital environments and media.
3. Research and information fluency	Students locate, organize, analyze, evaluate, synthesize, and ethically use information from a variety of sources and media.
4. Critical thinking, problem solving and decision making	Students plan and manage activities to develop a solution or complete a project.
5. Digital citizenship	<ul style="list-style-type: none"> <li>-Students advocate and practice safe, legal, and responsible use of information and technology.</li> <li>-Students exhibit positive attitude toward using technology that supports collaboration, learning and productivity.</li> <li>-Students demonstrate personal responsibility for lifelong learning.</li> <li>-Students exhibit leadership for digital citizenship.</li> <li>-Students understand and use technology systems.</li> <li>-Students select and use applications effectively and productively.</li> </ul>

## MATERIALS

- Computer/Ipad
- 3D printer
- 3D scanner
- Fossil samples
- 3D printing material (ie. PLA)
- Rulers or calipers
- Sticky Notes
- Poster paper

## KEY ACADEMIC AND/OR SCIENTIFIC LANGUAGE

**STEM:** Science, Technology, Engineering, and Mathematics

**3D File:** an electronic file representing a 3D object that is created by 3D modeling

**3D Model:** a mathematical representation of any three-dimensional surface of an object using Computer Aided Design (CAD) software

**Computer Aided Design:** software enables the creation of 2D or 3D models.

It originated in the architecture and manufacturing industries

**Additive Manufacturing:** the process of creating an object by fusing (adding) layer upon layer versus removing material

**Extruder:** is a device that forces material, hot or cold, through a die or template

Filament-is a thermoplastic that comes on a spool and is heated to its melting point to be extruded through a nozzle on the 3D printer

**Functional Prototype:** is a representation of a product used to evaluate form, fit and function, and not necessarily of the material of the final model

**X-axis:** the horizontal line on a graph

**Y-axis:** the vertical line on a graph

**Z-axis:** in a three-dimensional graphic, this usually refers to depth

**Build Platform:** Plate in which the 3D object is built

**3D Scanning:** a process that produces an image of the three-dimensional surface of an object

**Rotating stand:** platform that rotates the object to be scanned

**Part gripper:** part of the scanning equipment use to hold the object to be scanned

**Laser light:** high intensity light emitted by the scanner and detected by a camera inside the scanner

**Trim:** to clip the 3D image by removing what is unnecessary in the scanned image

**Stitch:** combining multiple scans together

**Fuse:** to blend together in one final model all the scanned data

**STL file:** a type of file used to save and export the final scan before it is 3D printed  
3D- having the dimensions of height, width, and depth

## PREREQUISITE KNOWLEDGE

N/A