

Think Like a 3D Printer: Exploring Cross-Sections and Layers

Subject: ADST, Mathematics, Science	Grade: 5–8	Duration: 60–75 min
Lesson Overview	Students investigate how three-dimensional objects can be represented as a series of two-dimensional layers. Through cross-section activities, they explore how additive manufacturing works and develop spatial reasoning by analyzing, drawing, and reconstructing objects layer by layer. The lesson introduces the fundamental concept behind 3D printing while encouraging students to think like designers and engineers.	

Curriculum Ties (in addition to satisfying multiple core competencies):

ADST Core Competencies:

Communication: E.g. Collaborating: Share progress while making sure to increase feedback and collaboration.

Thinking: E.g. Critical and Reflective Thinking: Screen ideas against criteria and constraints first, students will brainstorm and think consciously about their decisions before executing their plan.

Personal & Social: E.g. Social Responsibility: Evaluate the influences of land, natural resources, and culture on the development and use of tools and technologies on the construction of their tower

Mathematics (Geometry and measurement)

Big Idea grade 8: The relationship between surface area and volume of 3D objects can be used to describe, measure, and compare spatial relationships.

Content grade 3: construction of 3D objects

Content Objectives

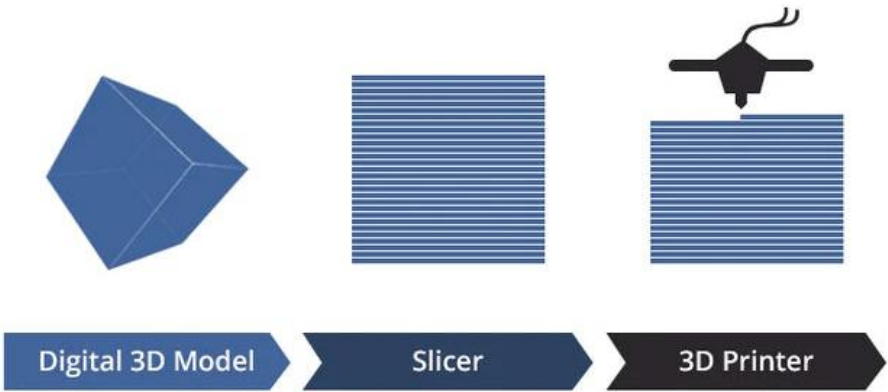
Students will:

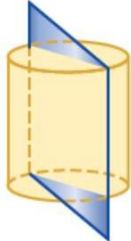
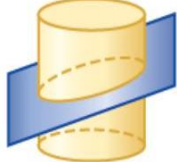
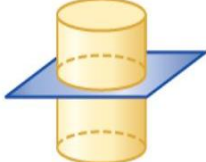
- Explain the basic principle of additive manufacturing.
- Identify cross-sections of common three-dimensional shapes.
- Represent a 3D object as a sequence of 2D layers.
- Recognize how complex objects can be built from simple geometric forms.

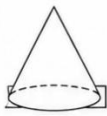
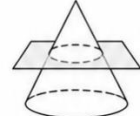
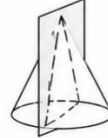
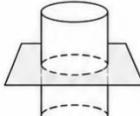
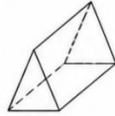
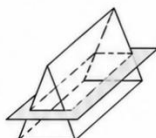
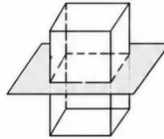
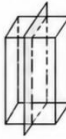
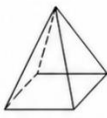
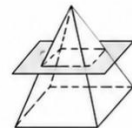
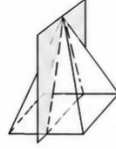
Materials & Equipment Needed

Consumables: • Cross-section worksheet • Paper • Pencils • Erasers	Non-Consumables: • Sample 3D printed object (optional)
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Lesson & Activity

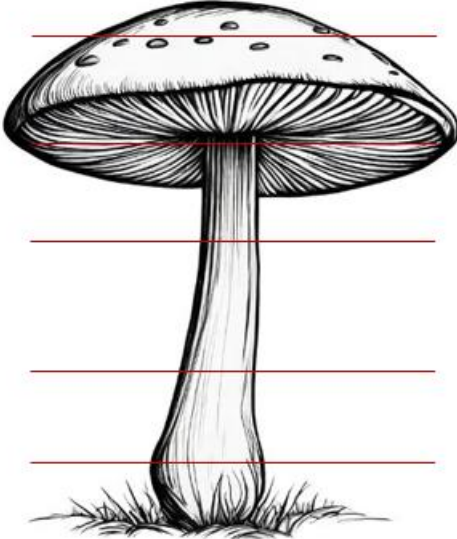
Lesson Stages	Learning Activities
Introduction	- Begin by asking students how they think a 3D printer creates an object. Facilitate a brief discussion comparing traditional manufacturing (cutting material away) with additive manufacturing (building objects layer by layer). - Show a short video or animation demonstrating the 3D printing process and explain that before printing, every object is digitally divided into hundreds of thin horizontal slices.  - How 3D printer works: https://youtu.be/f94CnlQ0eq4 - Introduce the idea of cross-sections and explain that today's challenge is to think like a 3D printer by representing three-dimensional objects as a series of two-dimensional layers.

	(Perpendicular to the base) Vertical Slice  The cross section is a rectangle. Angled Slice  The cross section is an oval. (Parallel to the base) Horizontal Slice  The cross section is a circle. Geometric Cross Section In geometry, a cross section is the intersection of a solid object with a plane. Cutting an object into slices produces multiple parallel cross sections, each showing the shape of the object at that location
Activity	Part 1: Cross-Section Worksheet • Distribute the Cross-Section Worksheet. Students examine a series of common three-dimensional solids (e.g., cone, cylinder, rectangular prism, triangular prism, square pyramid). • For each object, they observe the cutting plane and draw the resulting two-dimensional cross-section. Encourage students to justify their reasoning by discussing how the position and orientation of the cut changes the resulting shape. • Review the answers as a class, emphasizing that different cross-sections reveal different information about the same object.

3D Shape	Horizontal Cross Section	2D Shape	Vertical Cross Section	2D Shape
 cone				
 cylinder				
 triangular prism				
 rectangular prism				
 square pyramid				

Part 2: 3D object

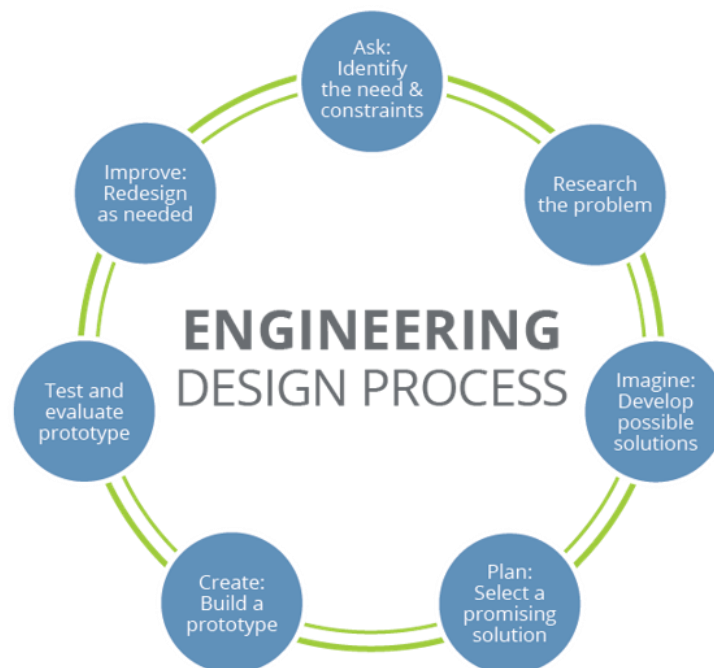
- Provide each student or group with an image of 3d object (for example, a mushroom). Explain that instead of drawing only one cross-section, they will imagine how the entire object would be built by a 3D printer.
- Students divide the object into five horizontal layers and sketch the cross-sectional shape of each layer from bottom to top.
- Encourage students to focus on how the size and shape gradually change between layers to recreate the overall form.

	- Once completed, compare different solutions and discuss why there is more than one possible representation.  Optional: have a physical 3D object for students to explore and imagine the cross sections.
Closure	- Review how stacking many simple two-dimensional layers can recreate complex three-dimensional objects. - Connect this idea to additive manufacturing by explaining that slicing software performs this process automatically before a model is printed. - Invite students to reflect on how increasing the number of layers would improve the accuracy and smoothness of the final object. - As an extension, challenge students to choose any everyday object, natural object, geometric solid, or classroom item and represent it as a series of horizontal layers, encouraging them to think about how engineers and designers simplify complex shapes during the prototyping process.

Step Ups & Step Downs	Step Ups • Use more complex objects with internal cavities. • Ask students to estimate the number of layers needed for a smooth print. • Introduce CAD software and show the slicing process. Step Down • Use only basic solids (cube, cylinder, cone, sphere). • Provide guide lines for the 3D object layers. • Complete the activity as a whole class before independent work.
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Background Knowledge

The Engineering Design Cycle:



- Ask
 - What is the problem we're trying to solve?
 - What are the limits that our solution needs to follow?

- Research
 - Has someone already created something like this?
 - Who are the experts in this field?
- Imagine
 - Brainstorm a large quantity and variety of ideas before narrowing the options.
- Plan
 - What criteria should we use to narrow down our ideas?
 - Which ideas need to be screened based on the original constraints we identified?
- Create
 - What kind of prototypes can we create? A sketch, scale model, CAD model, computer simulation, etc
- Test
 - What does our final design need to accomplish? Can we test this with the prototype we made?
 - Run an experiment
 - Create a computer simulation
 - What information are we looking to gain from these tests?
- Improve
 - Based on the results from the testing, what can we improve on our design?
 - Are there certain aspects we found too difficult to create?

Additional Resources

- How 3D printer works: <https://youtu.be/f94CnIQ0eq4>
- Cross-Section: <https://www.youtube.com/watch?v=MeARCoXD03M>