

The Art of Geometry

Written By: Vivian Moreira Komando, PhD

County: Walton

Subject: Art

Grade(s): 9th – 12th

Instructional Time: 8-10+ fifty-minute class periods

Suggested or Required Technology: Computer / device to access Tinkercad online, mouse, mouse pad, as well as internet access to view resources

BRIEF DESCRIPTION

Using Tinkercad and 3D printing, Drawing and 3D students will render basic 3D forms to create geometric works of art that incorporate intersecting forms.

STANDARDS

- VA.912.S.2.1 Demonstrate organizational skills to influence the sequential process when creating artwork. <https://www.cpalms.org/Public/PreviewStandard/Preview/4831>
- VA.912.S.1.4 Demonstrate effective and accurate use of art vocabulary throughout the art-making process.
- VA.912.S.3.6 Develop works with prominent personal vision revealed through mastery of art tasks and tools.
- VA.912.S.3.7 Use and maintain tools and equipment to facilitate the creative process.
- VA.912.O.1.1 Use the structural elements of art and the organizational principles of design in works of art to establish an interpretive and technical foundation for visual coherence.
- MAFS.912.G-CO.1.5 Given a geometric figure and a rotation, reflection, or translation, draw the transformed figure using, e.g., graph paper, tracing paper, or geometry software. Specify a sequence of transformations that will carry a given figure onto another. <https://www.cpalms.org/Public/PreviewStandard/Preview/5602>
- VA.912.S.2.6 Incorporate skills, concepts, and media to create images from ideation to resolution.

LEARNING OBJECTIVES

Introducing students to 3D printing using Tinkercad, students will:

- Use Drawing and/or 3D knowledge of basic 3D shapes to create geometric designs that incorporate intersecting forms.
- Organize forms so the forms connect and intersect in 3D space.
- Apply two or more transformations to a given form to draw/create a transformed 3D object.
- Individually specify a sequence of transformations that will incorporate / intersect a geometric form onto another.

GUIDING QUESTIONS

- How are Art and Geometry related?
- How do you combine 3D forms to create a piece of art?
- How does Drawing knowledge support 3D Design?
- How are balance and scale used in 3D Design?

PRIOR KNOWLEDGE NEEDED

Students are able to identify simple 2D shapes to 3D forms:

- Square to Cube / Rectangular form
- Triangle to Cone / Pyramid form
- Rectangle to Cylinder form
- Circle to Sphere form

Students are able to identify degrees of angles

FORMATIVE ASSESSMENT

In Tinkercad- Is the student able to:

- Set up work plane
- Drag desired object onto the work plane
- Determine a base form
- Resize objects – width, height, depth
- Move objects on the work plane
- Rotate the work plane
- Keep the base objects on the work plane
- Add 3 intersecting forms to the base form
- Change degrees of angles for both visual and physical balance
- Vary the scale of segments for both visual and physical balance

SUMMATIVE ASSESSMENT

The student will Create a 3D Geometrical Design to be 3D printed with 3 attached intersecting forms (4 parts), demonstrating visual and physical balance.

LESSONS

SESSION 1 and 2

Intro to Drawing 3D Forms from Basic Shapes

MATERIALS AND SUPPLIES

- Classroom Internet Projection Computer / Device
- Drawing Art I Forms
<https://www.pinterest.com/artzheart/drawing-art-i-forms/>
- SLICED AND DICED
<https://www.pinterest.com/artzheart/sliced-and-diced/>
- Drawing Paper
- Rulers
- Compass
- Pencils

ACTIVITIES AND INSTRUCTIONS

- Introduce how artists use geometry for drawing, from basic art forms to more complicated intersecting forms. Use Drawing Art I Forms
<https://www.pinterest.com/artzheart/drawing-art-i-forms/>
- Demonstrate how to draw forms from shapes using a ruler and compass.
- Have students practice drawing the forms. Keep the resource board up for students to view after you demonstrate and while they practice drawing. When students have successfully drawn the forms, continue with the next step.
- Once students are able to draw the forms, show the students how they can create interesting compositions by intersecting forms. Show students they can do this by overlapping one form over another. Demonstrate by drawing 2 overlapping forms.
- SLICED AND DICED
<https://www.pinterest.com/artzheart/sliced-and-diced/>
- Have student first combine 2 forms, i.e., cylinder and a sphere by overlapping as they draw.
- Review work as you circulate the class and show student exemplars of the work they have completed.
- Have student combine 3 forms, i.e., cube, cylinder and a sphere.
- Review work as you circulate the class and show student exemplars of the work they have completed.
- Discuss and have students evaluate if their work looks balanced or if their drawing looks like it might tip over.
- Ask students if any of the forms are too big or too small in their overall work.
- Ask students to consider how they can adjust / revise their sketches to balance their drawing.
- Have students select 1 form to be dominant and to then add 3 additional forms that vary in scale to create a third sketch. (These same steps will be repeated in Tinkercad.)

RESOURCES

Geometry and Art, Los Angeles County Museum of Art

[https://www.cpalms.org/uploads/resources/120026/Final Recommendation Placement Geometry and Art LACMA.pdf](https://www.cpalms.org/uploads/resources/120026/Final_Recommendation_Placement_Geometry_and_Art_LACMA.pdf)

Drawing Art I Forms

<https://www.pinterest.com/artzheart/drawing-art-i-forms/>

SLICED AND DICED

<https://www.pinterest.com/artzheart/sliced-and-diced/>

Facebook 3D Printing Club for Teachers

<https://www.facebook.com/groups/teachingwith3d/>

3d printing for noobs(beginners)

<https://www.facebook.com/groups/450632562376838/>

28 - 3D printing in education. A teacher's perspective / Benefits of 3D Printing

https://www.youtube.com/watch?v=PCrRkMjTR8&fbclid=IwAR0hKObOk8T5Eq_NY1nbTnFjvaEtd4xgVhXB9wFQYiS-D8JrC19yUsazkdA

ACCOMMODATIONS FOR INCLUDING ALL CHILDREN

Strategies for Differentiating Instruction Based on Content:

- Encourage thinking at various levels of Bloom's taxonomy.
- Use a variety of instructional delivery methods to address different learning styles.
- Break assignments into smaller, more manageable parts that include structured directions for each part.
- Choose broad instructional concepts and skills that lend themselves to understanding at various levels of complexity.

Based on Process:

- Develop activities that target auditory, visual, and kinesthetic learners.
- Create activities that vary in level of complexity and degree of abstract thinking required.
- Use flexible grouping to group and regroup students based on factors including content, ability, and assessment results.

Based on Product:

- Use a variety of assessment strategies, including performance-based and open-ended assessment. Balance teacher-assigned and student-selected projects.
- Offer students a choice of projects that reflect a variety of learning styles and interests.
- Make assessment an ongoing, interactive process.
- https://www.ritenour.k12.mo.us/cms/lib/MO01910124/Centricity/Domain/69/Differentiating_Instruction.pdf

Demonstrate: Show students what a successful performance looks like.

Construct: Provide materials and ask students to design and create an original project — a model,

Reciprocal Teaching: Ask students to teach what they have learned to others in a group or the class as a whole.

Generate: Require students to be thinkers who come up with their own questions and problems, answers and solutions.

<https://www.scholastic.com/teachers/articles/teaching-content/fifteen-ways-vary-instruction/>

SESSION 2 and 3

Intro to 3D Creating for 3D Printing with Tinkercad / Tinkercad Classroom

MATERIALS AND SUPPLIES

- Teacher Exemplar – if possible – created prior to the lesson
- Computer / Device access to Tinkercad <https://www.tinkercad.com/>
- Tinkercad Tutorial Part 1 - (Interface and Movement)
<https://www.youtube.com/watch?v=2JFxtUIOnEI&t=300s>
- Tinkercad Tutorial Part 2 - (Shape Manipulation and Scaling)
<https://www.youtube.com/watch?v=Xy6EugocJKI>
- Tinkercad Classroom <https://blog.tinkercad.com/2019/08/05/introducing-tinkercad-classroom/>

ACTIVITIES AND INSTRUCTIONS

- Place students in groups to share and critique their last sketch of 3 intersecting forms on one base form, which they completed in the last class. (Assign a time frame for your student group discussions based on your class and group size.)
- Ask students to comment on why a shape works or does not work in the drawing.
- Ask students to offer suggestions on creating a better visual balance if needed.
- Circulate as groups critique / evaluate.
- Have Tinkercad site up for students.
- Once the group activity is completed, introduce Tinkercad and explain that the students will be making a 3D model of the intersecting forms using Tinkercad and that their models will be 3D printed.
- To introduce how Tinkercad works, show the tutorials for the students to become familiar with the program. Pace the tutorials for your class level and allow time for questions.
- Tinkercad Tutorial Part 1 - (Interface and Movement)
<https://www.youtube.com/watch?v=2JFxtUIOnEI&t=300s>
- Tinkercad Tutorial Part 2 - (Shape Manipulation and Scaling)
<https://www.youtube.com/watch?v=Xy6EugocJKI>
- Create your Tinkercad Classroom for your student accounts:
<https://www.tinkercad.com/teach>
- Review and demonstrate how to access student accounts. Have students sign in to their accounts.
- Review and demonstrate the work plane and settings. Set to inches if you prefer your students work in inches.
- Review and demonstrate how to drag and resize an object. Have students do the same.
- Circulate as students work to help as needed.
- Show students how files are automatically saved for the next class period.

RESOURCES

Tinkercad Tutorial Part 1 - (Interface and Movement)

<https://www.youtube.com/watch?v=2JFxtUIOnEI&t=300s>

Tinkercad Tutorial Part 2 - (Shape Manipulation and Scaling)

<https://www.youtube.com/watch?v=Xy6EugocJKI>

Tinkercad Tutorial Part 3 - (Group, Hole, Align, and Flip Tool)

<https://www.youtube.com/watch?v=hbQww7pWGt4>

Tinkercad Tutorial Part 4 – (Workplane, Ruler, Blocks and Bricks)

<https://www.youtube.com/watch?v=aa2uboMStVQ>

ACCOMMODATIONS FOR INCLUDING ALL CHILDREN

Same as listed above.

SESSION 4 - 6

Create Mini Versions – Combining Forms / Practice

MATERIALS AND SUPPLIES

- Teacher Exemplar – Demonstrated
- Computer / Device access to Tinkercad <https://www.tinkercad.com/>

ACTIVITIES AND INSTRUCTIONS

- Have students watch as you create a mini version with 2 segments (2 total parts) class demonstration.
- Teacher Exemplar – Demonstrate and create a base form with a second intersecting form.
- Address possibilities for scale, balance, and angles and show variations as you demonstrate.
- Have students sign in to Tinkercad and begin their 2-segmented composition (2 total parts) for practice using Tinkercad. Have students refer to their earlier drawings as they work.
- Indicate to students how all views are not possible in their drawings, but need to be considered before 3D printing.
- Review with each student, rotating the work plane with the student so all views are considered in the 3D composition.
- Once students complete this task with your review, have them create a base form with 2 segments (3 total parts).
- Review with each student, rotating the work plane with the student so all views are considered in the 3D composition. Also, as the composition is more complicated, review angles and the space between segments.
- Advise students not to cluster the segments closely together on one side, but to think of their work as a sculpture in the round to be viewed in 360 degrees.
- Gallery: Using your Tinkercad classroom, have students open their account to share their beginning creations as a digital gallery.

RESOURCES

Tinkercad <https://www.tinkercad.com/>

ACCOMMODATIONS FOR INCLUDING ALL CHILDREN

Same as listed above

SESSION 7 - 8

Final Project - Students create geometric works of art that incorporate intersecting forms (4 parts).

MATERIALS AND SUPPLIES

- Teacher Exemplar – 3D Printed (in advance of lesson)
- Computer / Device access to Tinkercad <https://www.tinkercad.com/>

ACTIVITIES AND INSTRUCTIONS

- After student practice and teacher review, students are to create their final project (to be 3D printed) using the skills and knowledge they have acquired in their practice and reviews.
- Students sketch 3 variations of a base form with 3 intersecting forms (4 parts).
- Teacher / student dialogue in regards to the 3 composition in 3D space.
- Students begin designing chosen design in Tinkercad.
- Let students know that change during their designing process in Tinkercad is acceptable.
- Once the students have completed their design, teacher and student dialogue will ensue regarding the final design, and any revisions (if needed) are complete, the teacher will proceed with the 3D printing of the final project for each student.
- All student projects are to be printed
- Problems with any final 3D printed works will need to be addressed and corrected, which may result in a second printing of the work.

RESOURCES

Teacher Community

<https://www.instructables.com/teachers/community/>

Blog

<https://blog.tinkercad.com/>

Inspiration

<https://blog.tinkercad.com/tag/inspiration>

Tips Tricks

<https://blog.tinkercad.com/tag/tips-tricks>

3D Printing Materials Guide for Classrooms

<https://blog.tinkercad.com/3d-printing-materials-guide>

Instructables

<https://www.instructables.com/workshop/projects/>

ACCOMMODATIONS FOR INCLUDING ALL CHILDREN

Same as listed above.

SESSION 9 – 10 and Follow Up

Gallery / Final Critiques

MATERIALS AND SUPPLIES

- Students 3D printed works
- Display area

ACTIVITIES AND INSTRUCTIONS

- Once final projects are completed, arrange for an area to display the students' works.
- Allow time for the students to view their peers' artwork.
- Have each student present his or her work.
- Have each student speak to:
 - A. The most difficult part of the assignment
 - B. The most successful part of the assignment
 - C. What the student would change about the work if they were to re-do it
 - D. What the student would design next using Tinkercad and 3D printing.

Follow up:

- A. Some students may work at a higher level. Be open to more complicated designs.
- B. Allow time for play and experimentation using Tinkercad. Have students create a "Choice" design in Tinkercad.
- C. Show students the Bricks option in Tinkercad and introduce a new project using Bricks <https://tinkercad.zendesk.com/hc/en-us/articles/115012284447-How-do-I-use-the-Bricks-workspace-in-Tinkercad->

RESOURCESUsing Bricks in Tinkercad- <https://tinkercad.zendesk.com/hc/en-us/articles/115012284447-How-do-I-use-the-Bricks-workspace-in-Tinkercad->**ACCOMMODATIONS FOR INCLUDING ALL CHILDREN**

Same as listed above.

COMMENTS OR GENERAL NOTES

Teachers may need information on how to prepare and print projects / using a slicer.







