



Shapes

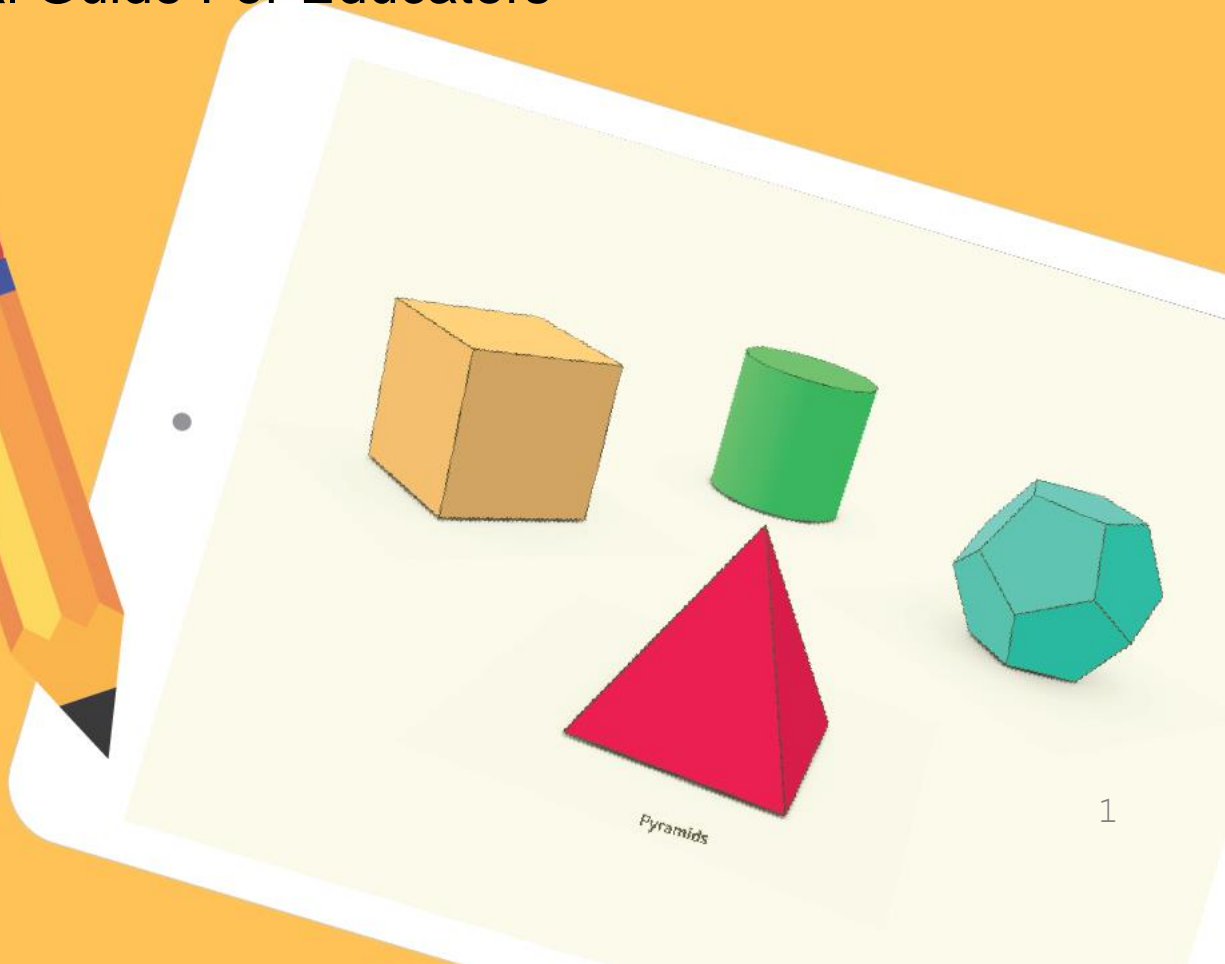
learn | teach | explore



MIDDLE SCHOOL

Geometry Lesson Plans

A Practical Guide For Educators



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Introduction

This is a set of lesson plans that complement the app 'Shapes - 3D Geometry Learning' on the **iPad, Android tablet or desktop computer**. These are suggested devices to use in the classroom, but teachers may use also other Android or iOS mobile devices. An experienced educator who has taught every single grade ranging from kindergarten to twelfth grade wrote the lesson plans. Too often teachers find an app they like but are unable to find the time to align it with the curriculum that they are required to teach. Our intent with these plans is to allow the teachers using them to be able to access the lesson plans and seamlessly integrate the plans into their teaching.

The 'Shapes' lesson plans are divided into two groups, one set of lesson plans for younger students and one set of plans for older students. This is the older students set of plans which can be used with middle school and high school students and they are lessons seven through ten. For the teachers of older children there are lessons for grade six, grade seven, grade eight, and grade ten. Geometry is not taught in ninth grade in the United States so that is why there is no grade nine lesson plan.

The lesson plans are ready to use in the classroom. The purpose of these lessons is to encourage the acquisition of various math skills through creative play. These lessons cater to students who have a variety of learning styles and emphasize visual learning as well as hands-on kinesthetic activities. Each lesson plan has the same organizational structure. There is a lesson title. The next element in the lesson objective which is in the SWBAT format, students will be able to followed by an action verb related to learning. Most lessons in the set have more than one lesson objective with action verbs from Bloom's Taxonomy. The third element of each lesson is the Common Core State Standards to which they are aligned. Next there is an activity title followed by a list of materials needed to teach the lesson and suggested amount of time/number of classes that the teachers should use to teach the lesson. After that there is an activity description which explains how to execute the lesson. Finally, each lesson ends with the supporting worksheet.

The benefit of using these lessons is not only that you will be teaching your students math lessons and skills that are aligned to the Common Core State Standards, but you will also see high levels of engagement in your classroom. This current generation of students who sit in our classrooms are digital natives and they respond well to instruction that infuses technology into the lesson plans.



If your classroom is equipped with iPads using ARKit you may use Augmented Reality features with which students can place solids on their desks and examine them in 3D.



“Shapes - 3D Geometry Learning” app is integrated with Schoolwork app available on iPads. Schoolwork helps you easily distribute and collect assignments, keep an eye on student progress in educational apps, and collaborate one on one with students from anywhere, in real time.

LESSON SEVEN

Using Shapes in the 6th Grade

Multi-Disciplinary Project on the History of the Platonic Solids

Teachers using Shapes at the sixth grade level could use the following lesson objectives in their lesson plans:

- SWBAT identify the number of faces, vertices, and edges there are in different platonic solids
- SWBAT calculate the surface area of the five platonic solids
- SWBAT synthesize information about the history of polyhedra and the platonic solids with hands-on application knowledge in an iMovie, WeVideo, Power Point or similar software for presentation purposes, or oral report

This lesson relates to the following Common Core State Standards: Solve real-world and mathematical problems involving area, surface area, and volume.

CCSS.Math.Content.6.G.A.1

Find the area of right triangles, other triangles, special quadrilaterals, and polygons by composing into rectangles or decomposing into triangles and other shapes; apply these techniques in the context of solving real-world and mathematical problems.

CCSS.Math.Content.6.G.A.3

Draw polygons in the coordinate plane given coordinates for the vertices; use coordinates to find the length of a side joining points with the same first coordinate or the same second coordinate. Apply these techniques in the context of solving real-world and mathematical problems.

CCSS.Math.Content.6.G.A.4

Represent three-dimensional figures using nets made up of rectangles and triangles, and use the nets to find the surface area of these figures. Apply these techniques in the context of solving real-world and mathematical problems.

Activity Seven Part One – Using the Worksheets Below Students Practice the Concepts of Counting Edges, Faces, Vertices, and Calculate Surface Area of Each Object

Activity Seven Part Two - Using the Nets Section of the Shapes App, students create a net for each of the 5 platonic solids and print out the nets and use these 2d print out to build 3D Platonic Solids

Activity Seven Part Three - Students Use the Knowledge You Have Gained in Parts and Two Apply that Knowledge to Create an Multimedia or Oral Presentation



Materials Needed:

- Part One: Class Set of the Worksheets Below, Writing Utensil for each student, if you are in a 1 to 1 environment the worksheets can be filled out digitally and submitted digitally depending upon the infrastructure
- This activity may be easily managed with Schoolwork, so that students can add their Worksheet to the assignment handed out by teacher with a link to the Shapes app screen
- If students have iPads with ARKit they can examine 3D shapes in Augmented Reality when completing the activity. They only need to click AR button when a displaying a single solid in Shapes app
- Part Two: An iPad, Android tablet or desktop computer for each student in the class. If you are not in a 1 to 1 setting students can work in pairs; also need a set of class scissors, set of glue sticks, and you will also need the capacity to print out the nets of platonic solids once you create them in the class.
- Part Three: iPad, Android tablet or desktop computer if the students are completing the slide deck or video presentation. If the school has more bare bones technology the students can complete the oral presentation choice for the project.



Suggested Time Frame for the Activity:

- Part One: 45 to 60 minutes of class time
- Part Two: 60 minutes of class time

- Part Three: This summative activity will take one to two weeks: add on an additional one to two class periods to allow the students to present their work

Activity description:

This is Our Sixth Grade Lesson, But Since It Is Very Open-Ended You Could Adapt the Project to Another Grade Level Based Upon the Needs of Your Students.

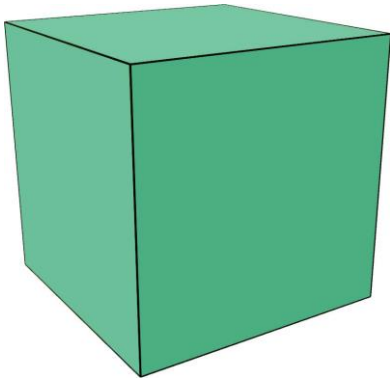
Teachers provide the following background information for the students.

The platonic solids are regular polyhedra. This is a Greek word meaning “many faces”.

There are five platonic solids that are defined by the fact that each one of their faces is a regular polygon, a polygon with equal angles and equal sides.

- Before you open your Shapes App, please complete the following exercise
- There are images of the five platonic solids on the worksheet below
- Please identify each of the following platonic solids
- Once you have identified each of the platonic solids, please identify how many faces the solid has, how many vertices, and how many edges.

Activity Seven Worksheet



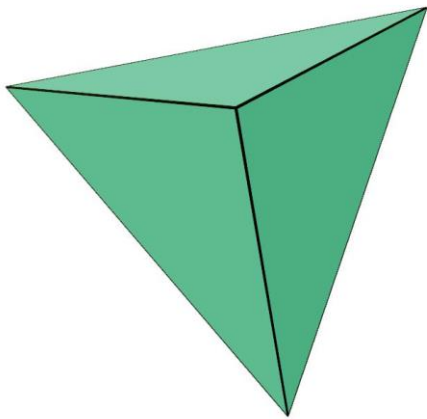
Name:

How many faces?

How many vertices?

How many edges?

What is the surface area of the figure?



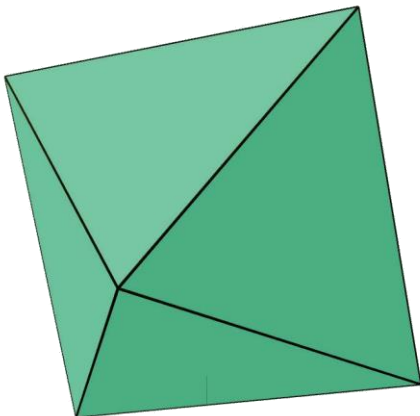
Name:

How many faces?

How many vertices?

How many edges?

What is the surface area of the figure?



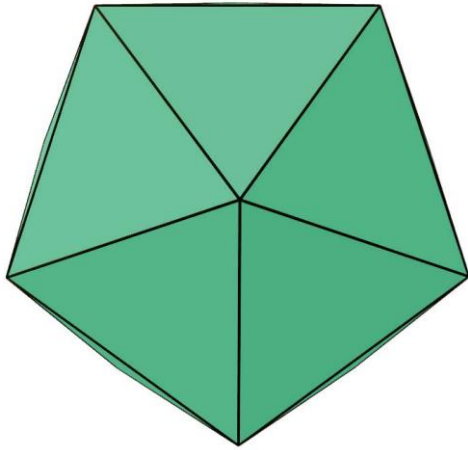
Name:

How many faces?

How many vertices?

How many edges?

What is the surface area of the figure?



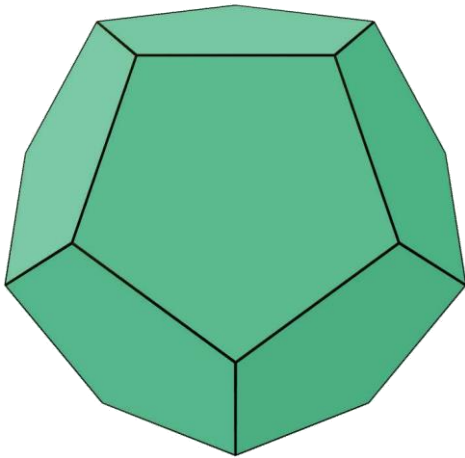
Name:

How many faces?

How many vertices?

How many edges?

What is the surface area of the figure?



Name:

How many faces?

How many vertices?

How many edges?

What is the surface area of the figure?

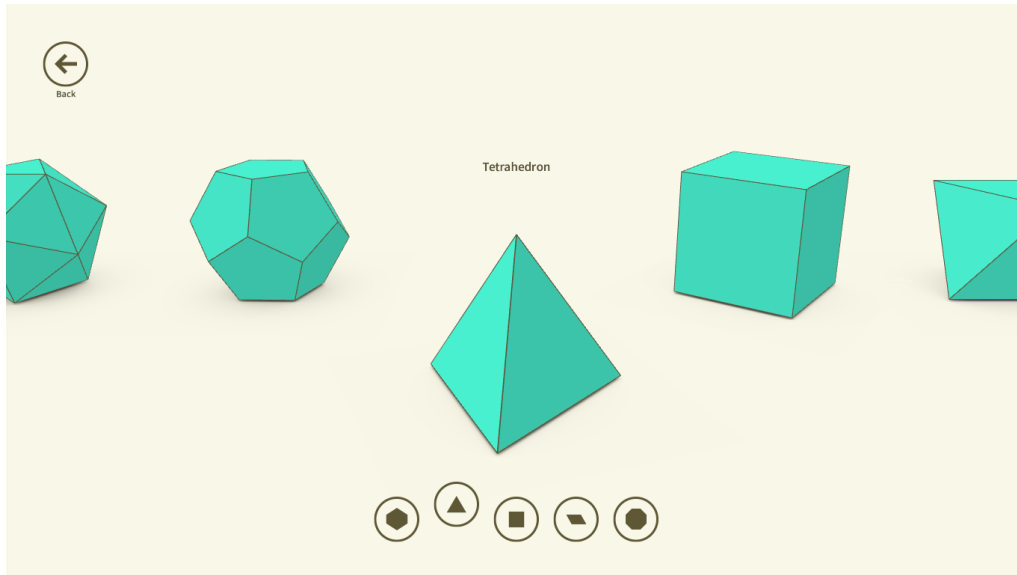
Once you have completed the first step in this exercise, please go into the platonic solids section of the app and complete the nets exercise for each one of the five platonic shapes. Below is a series of screen shots showing how to do this.

This activity may be easily managed with Schoolwork, so that a teacher may redirect students to the Step 3 and monitor their progress on-line.

In order to do that a teacher:

- 1) creates a handout in Schoolwork
- 2) adds an activity and chooses Shapes app
- 3) chooses „Platonic solids: Tetrahedron” from building nets activities.

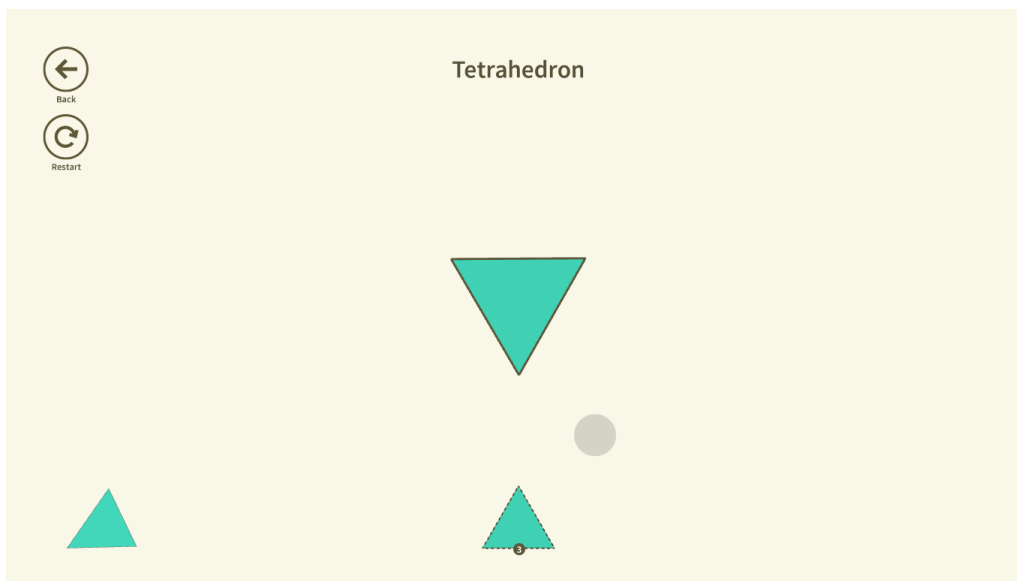
STEP 1

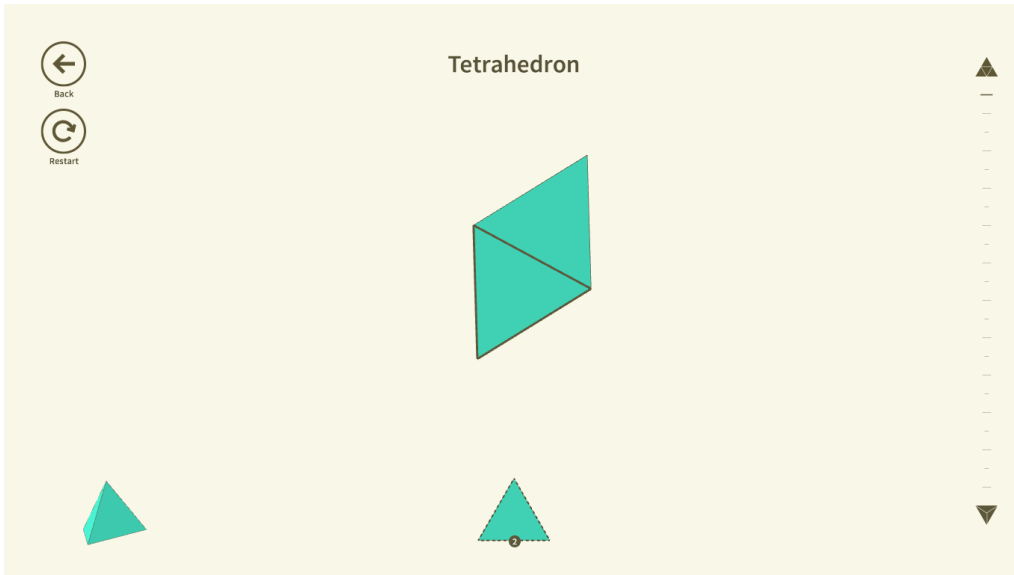


STEP 2

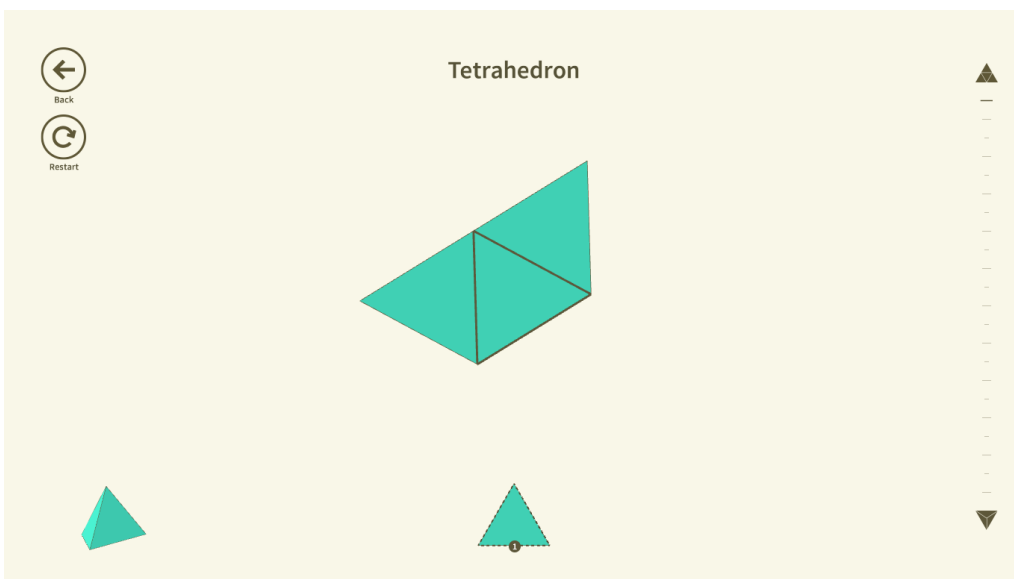


STEP 3

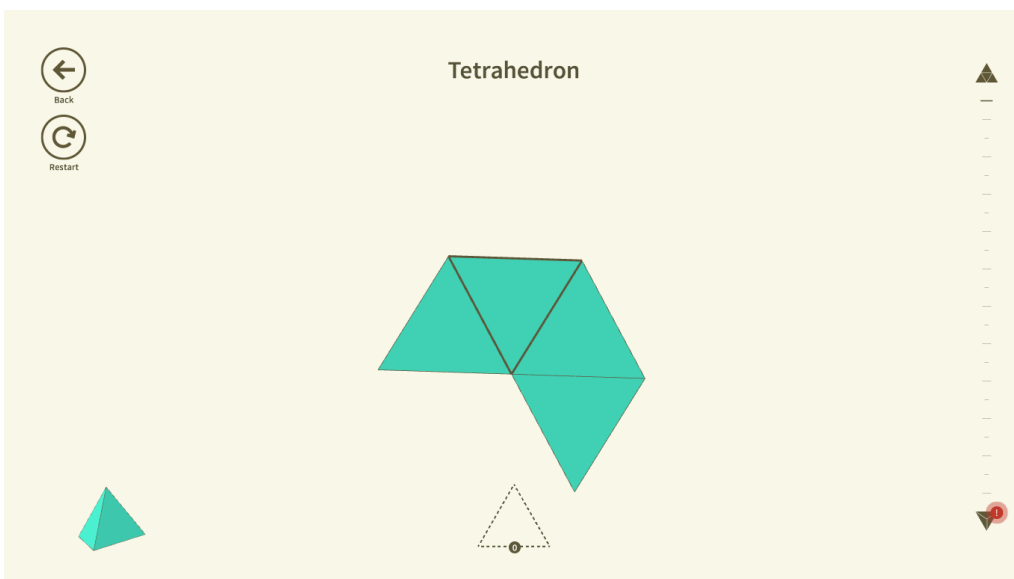




STEP 4

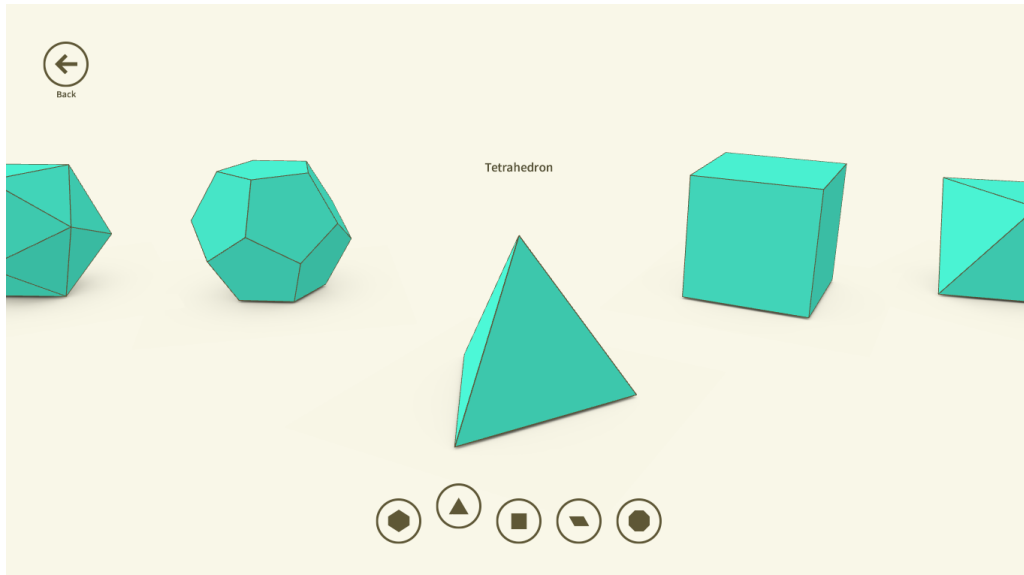


STEP 5



STEP 6

STEP 7



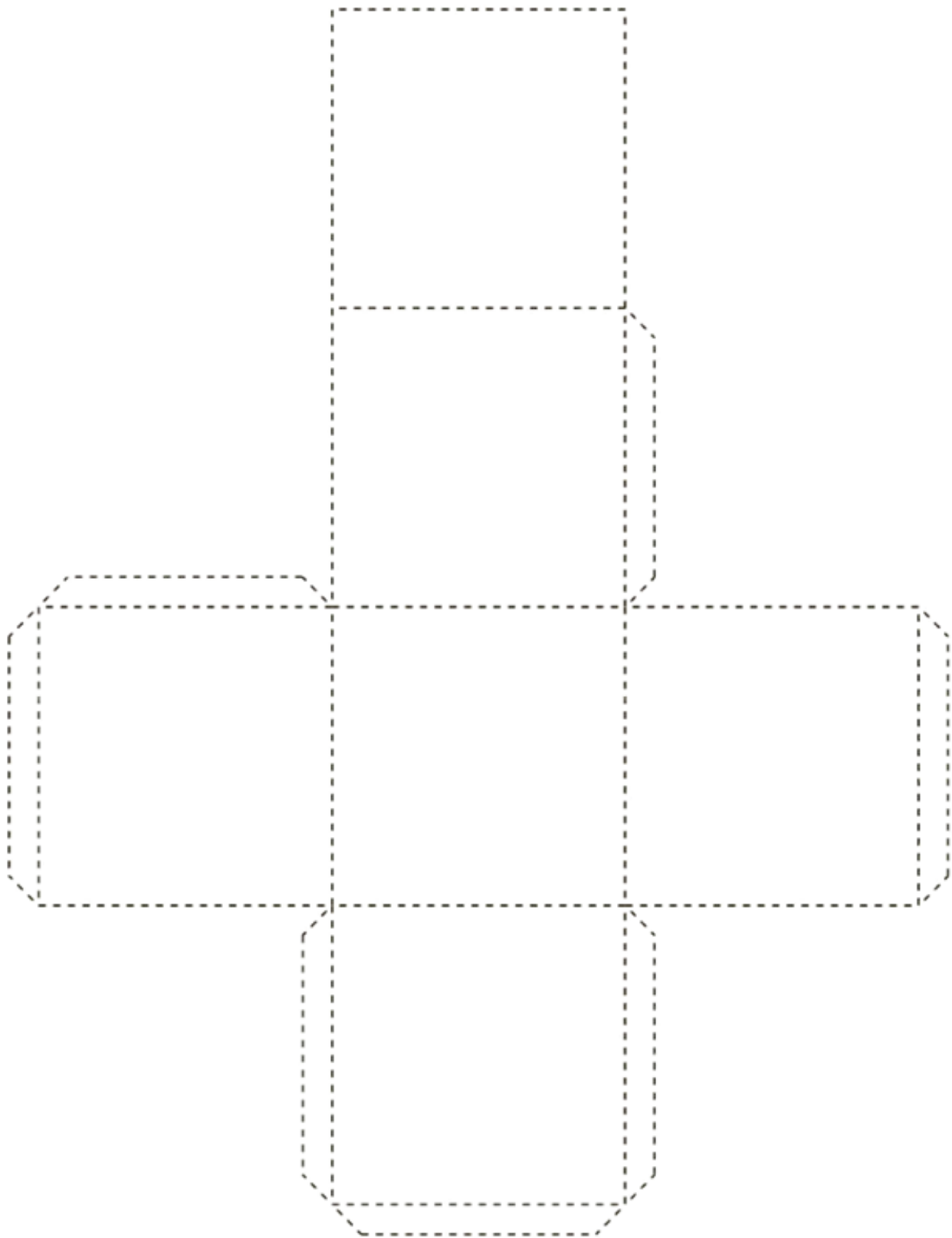
Once you have successfully created the shape within the nets section of the app, choose the print option for each shape and print out the five platonic solids:

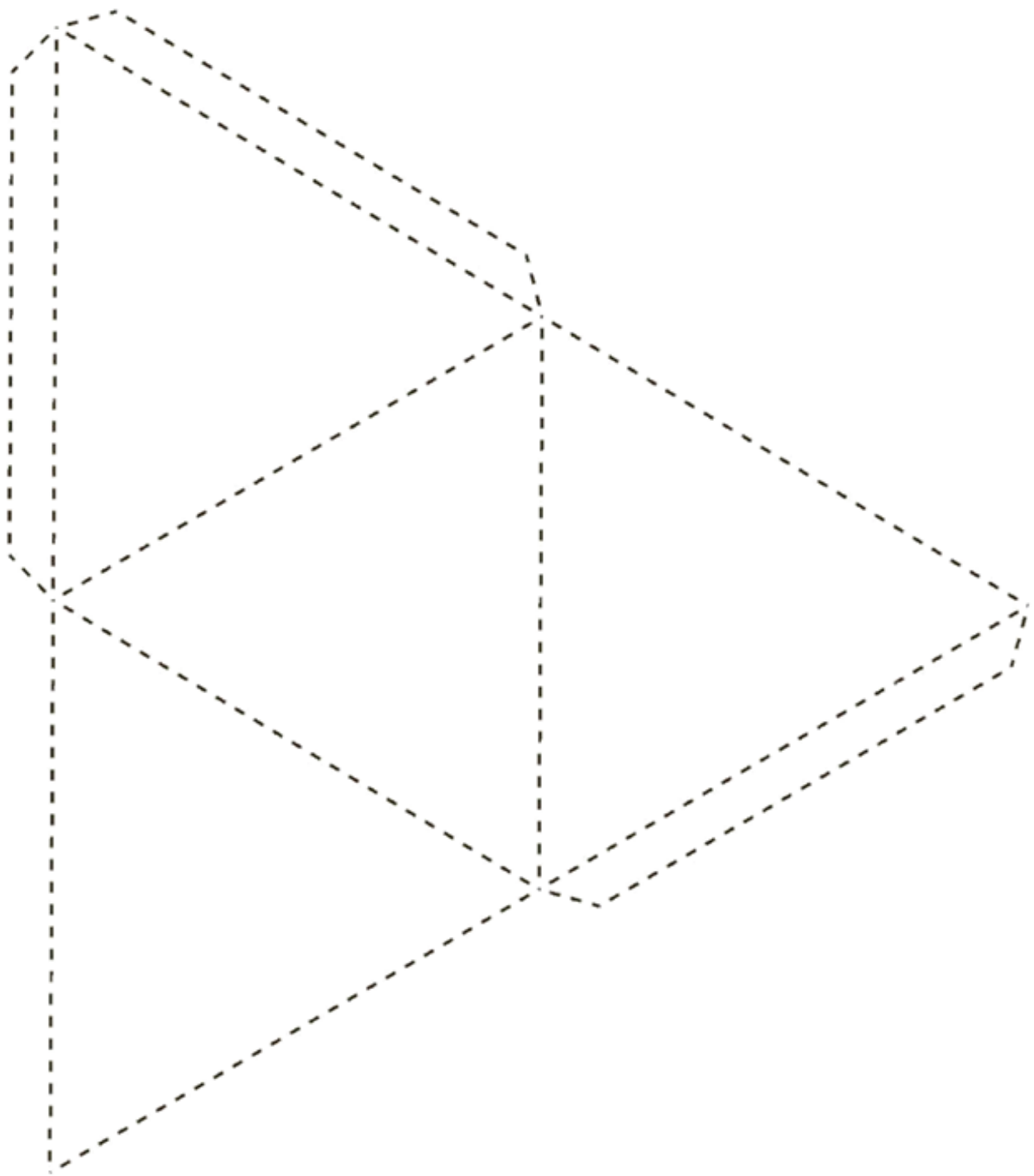
STEP 8

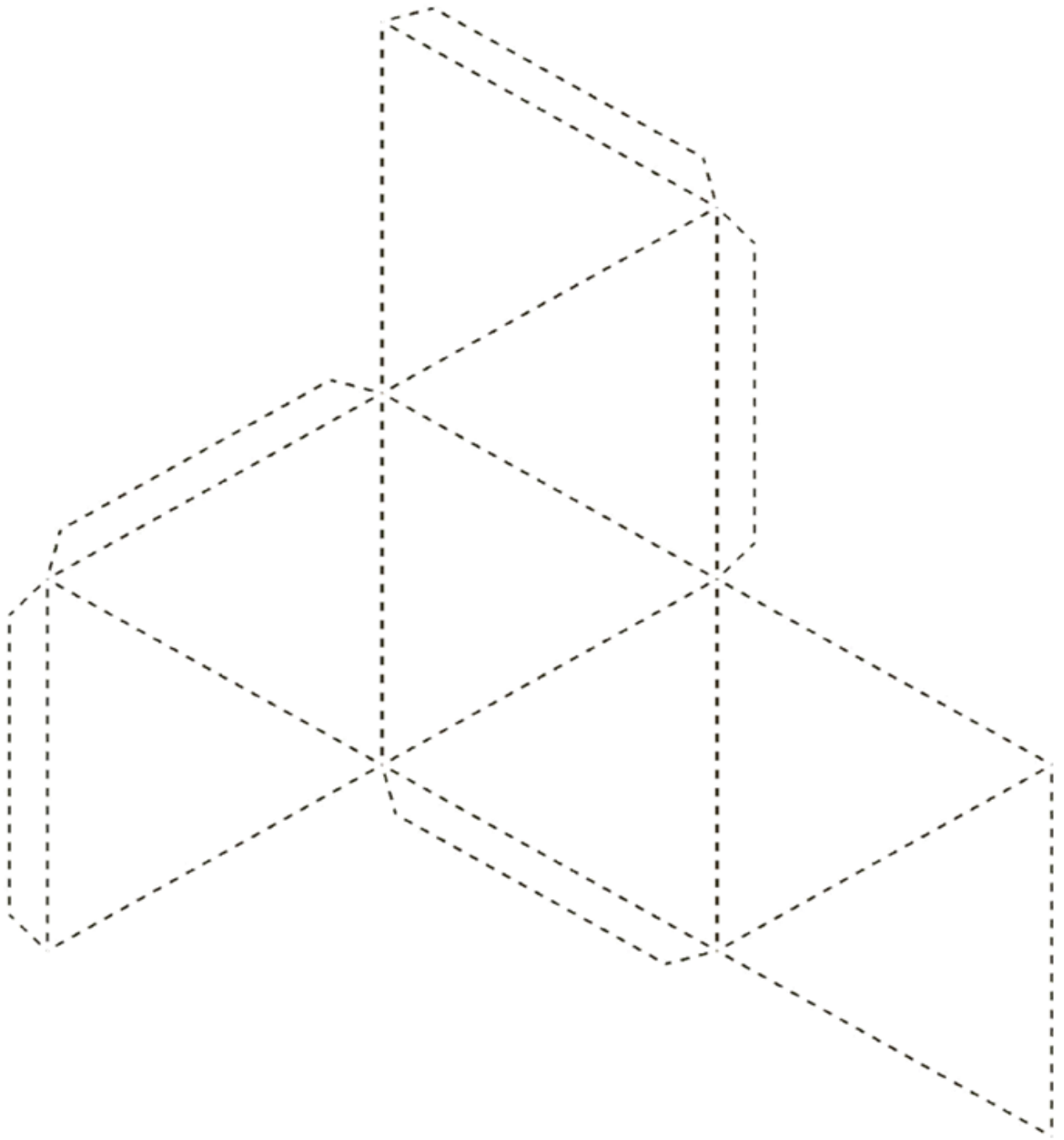


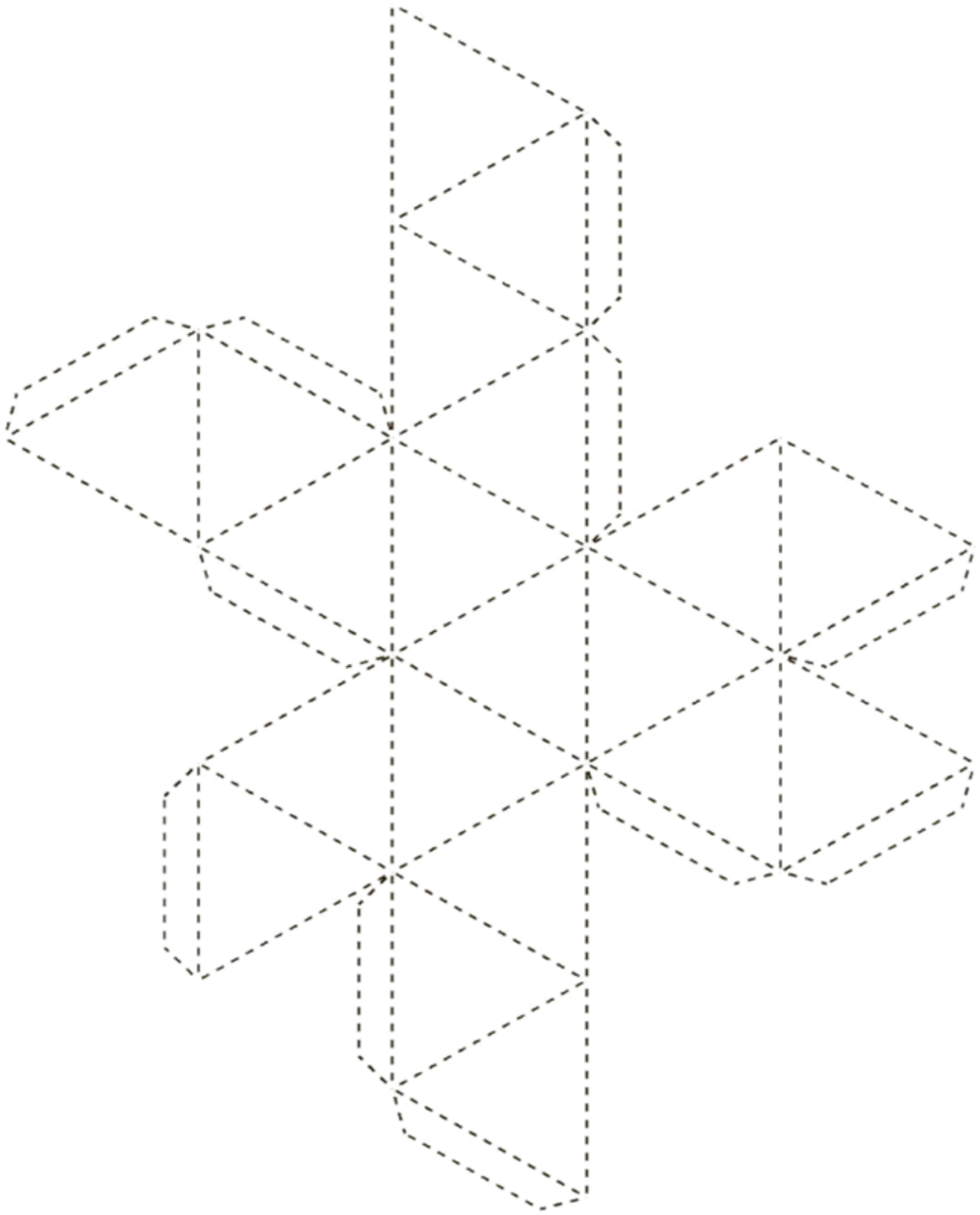
So you will print out the nets as displayed below.

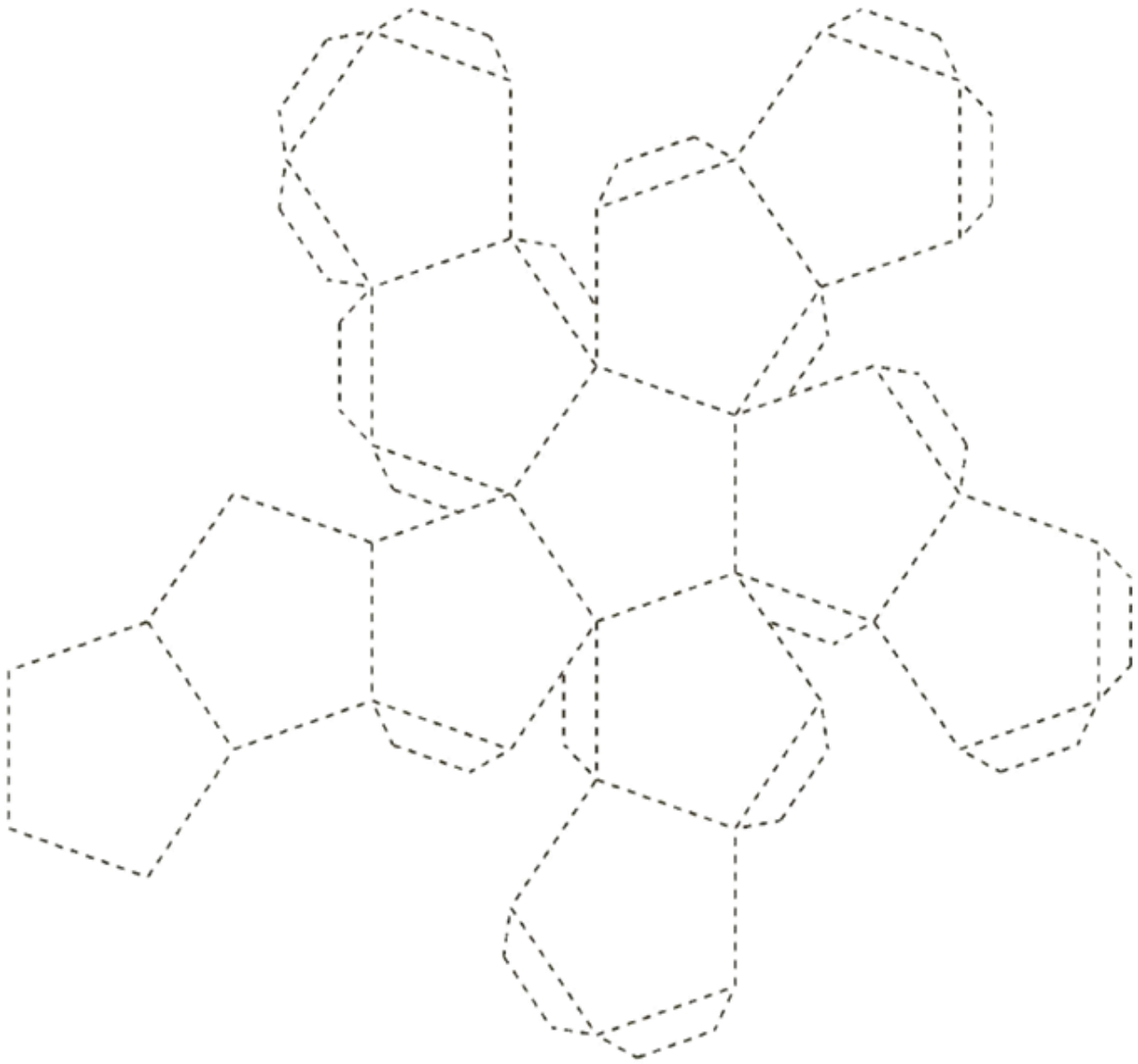
This activity may be easily managed with Schoolwork so that students can add PDF with a net if a teacher requests this as an item in a handout.











- Partner Activity, After You Print Out the Five Platonic Solids Please Build the Five Shapes in the Classroom
- Once you have completed this create an iMovie, WeVideo, PowerPoint slide presentation, or dramatic skit with your partner about the history of the platonic solids and the modern day application of the surface area formulas
- Your presentation should include the following people as they relate to the history of the platonic solids
 - Plato
 - Kepler
 - MC Escher
 - Paul Carter
- Your presentation should also talk about how you use the formulas for surface area to calculate the surface area of each of the Platonic Solids.

LESSON EIGHT

Using Shapes in the 7th Grade

Teachers using Shapes at the seventh grade level could use the following lesson objectives in their lesson plans:

- SWBAT determine the area of triangles, pentagons, squares
- SWBAT determine the surface area of the five platonic solids

This lesson relates to the following Common Core State Standards: Solve real-life and mathematical problems involving angle measure, area, surface area, and volume.

CCSS.Math.Content.7.G.B.6

Solve real-world and mathematical problems involving area, volume and surface area of two - and three-dimensional objects composed of triangles, quadrilaterals, polygons, cubes, and right prisms.

Activity Three - Screencasting Shape Lesson



Materials Needed: (this depends upon how many choices are available to your students):

- Class set of the 5 nets worksheets that can be found in lesson six
- Rulers, pencils
- Formula cheat sheet (depending upon the level of scaffolding you would like to provide - see below)

Formula Cheat Sheet

Area of a triangle = $\frac{1}{2}$ base * height

Area of a square = side * side

Area of a pentagon = perimeter * apothem/2

If your classroom is 1:1 environment equipped with iPads using ARKit you may use Augmented Reality features with which students can place solids on their desks, unfold their nets and examine them without the need to print them



Suggested Time Frame for the Activity:

- Depending upon the level of the students this lesson could take 30-60 minutes

Activity description:

- This lesson is connected to elements in lesson six and the nets feature of the Shapes App
- The classroom teacher will print out the five nets worksheets that were displayed in lesson six and distribute them to the students
- As an alternative, if a classroom is a 1:1 using iPads with ARKit, a teacher may ask students to click AR button when one of the five solids from lesson six is displayed in Shapes app, then instruct students to place a solid in front of them and unfold a net in AR mode.
- The students will measure the base and height of the triangle faces in the Tetrahedron
- Based upon this base and the height measurement the students will calculate the area of each face of the tetrahedron and the surface area of the platonic solid
- The students will measure the base and height of the triangle faces in the Octahedron
- Based upon this base and height measurement the students will calculate the area of each face of the octahedron and the overall surface area of the platonic solid
- The students will measure the side and apothem of the pentagon faces in the Dodecahedron

- Based upon this apothem and side measurement the students will calculate the area of each face of the dodecahedron and the overall surface area of the platonic solid
- The students will measure the base and height of the triangle faces in the Icosohedron
- Based upon this base and height measurement the students will calculate the area of each face of the icosahedron and the overall surface area of the platonic solid

This activity may be easily managed with Schoolwork, so that students can add their worksheets to the assignments handed out by teacher with a link to the Shapes app.

Activity Eight Worksheet

Shape	Base	Height (in case of the Dodecahedron this column will be the apothem)	Area of One Face on the Platonic Solid	Overall Surface Area of the Platonic Solid
Dodecahedron				
Tetrahedron				
Cube				
Octahedron				
Icosahedron				

LESSON NINE

Using Shapes in 8th grade

Teachers using Shapes at the eighth grade level could use the following lesson objectives in their lesson plans:

- SWBAT create real world problems involving the formulas for cylinders, cones, and spheres

This lesson relates to the following Common Core State Standards: Solve real-world and mathematical problems involving volume of cylinders, cones, and spheres.

CCSS.Math.Content.8.G.C.9

Know the formulas for the volumes of cones, cylinders, and spheres and use them to solve real-world and mathematical problems.

Activity Nine - The students will create word problems related to the Solids of Revolution Figures in the Shapes App



Materials Needed: (this depends upon how many choices are available to your students):

Shapes app on iPads, Android tablets or desktop computers pencil and paper class set of worksheets (see below) signs for stations (Station One, Station Two, Station Three, Station Four)

Formula Cheat Sheet

Volume of a Cylinder = $V = \pi r^2 h$

Volume of a Sphere = $V = \frac{4}{3} \pi r^3$

Volume of a Cone = $V = \pi r^2 h / 3$



Suggested Time Frame for the Activity:

This lesson should be taught in separate pieces; one lesson should be the creation of the word problems (45 minutes), and the other lesson should be the Station Activity where the groups solve each other's problems (45 minutes)

Activity description:

- This lesson is connected to the Solids of Revolution Section of the Shapes App. The teacher will bring up the solids of revolution section in the shapes App and show the cylinder, cone, and sphere
- The teacher will use this as an opportunity to review the volume formulas for cones, cylinders, and spheres
- The teacher and the students will then brainstorm examples of where you see examples of cones, spheres, and cylinders in everyday life (i.e. ice cream cones, soda cans, baseballs, etc.)
- After the brainstorming activity, the students will then break up into groups of three or four
- Each group will be required to create three word problems 1) related to finding the volume of a cylinder 2) related to finding the volume of a cone 3) related to finding the volume of a sphere – the word problems must involve the occurrence of the shape in the everyday world based upon brainstorming done as a class The word problems can be generated on paper or they can take on a digital output like a screencast on the iPad, Android tablet or desktop computer;
- Once the class has completed the word problems, the teacher should set the class up in stations
- Groups will circulate through stations and complete word problems created by their peers
- Teacher will collect data while this is going on (How long did it take for the students to solve a problem? How accurate was the answer?)

This activity may be easily managed with Schoolwork, so that students can add their worksheets to the assignments handed out by teacher with a link to the Shapes app.

Solid of Revolution	Real life examples of shapes	Create Your Own Word Problems for Each Solid
Cone		
Cylinder		
Sphere		

LESSON TEN

Using Shapes in the 10th Grade

Teachers using Shapes at the tenth grade level could use the following lesson objectives in their lesson plans:

- SWBAT create real world problems involving the concepts of density, area, and volume
- SWBAT calculate the density of the prism when given the mass and volume of that object.

This lesson relates to the following Common Core State Standards: Apply geometric concepts in modeling situations:

CCSS.Math.Content.3.G.A.1

Apply concepts of density based on area and volume in modeling situations (e.g., persons per square mile, BTUs per cubic foot).

Activity Ten - The students will create word problems related to the Prisms section on the Shapes App

The students will create screencasts solving these word problems

The students will create QR Codes that link to their word problems

The students will solve the word problems created by their peers



Materials Needed:

- Shapes app on iPads, Android tablets or desktop computers
- QR Code Reader app on the chosen device
- Computers to Create QR Codes on the Following Website: <http://www.qrstu.com/>
- Writing Utensils
- Class Set of Worksheets
- Measurement Tool
- Scissors, tape, and glue

- Volume Formula Website Cheat Sheet for the Prisms (see links below)
<http://www.math.com/tables/geometry/volumes.htm>
http://www.softschools.com/math/geometry/volume_of_a_isotrianprism/
<http://funwaytolearnmath.jimdo.com/geometry/volume-of-trapezoidal-prism/> Weighing device like a triple beam balance



Suggested Time Frame for the Activity:

The students should create the word problems related to their specific prism in one class and this should take 45 minutes. It will take an additional 45 minutes for them to create the QR Codes and the permanent product aspect of their project in Nets feature of the Shapes App The QR Code Gallery walk in which the students will scan the QR Codes on the Prisms of their classmates will take 90 minutes, and can be done in one or two classes depending upon whether or not you have block scheduling

This activity may be managed with Schoolwork, so that teachers can easily:

- Redirect students to a specific 3D shape in the net creator mode
- Monitor students' progress when creating nets of 3D shapes
- Collect worksheets with calculations made by students
- Collect students' screencasts/videos and/or QR Codes.

Activity description:

- The teacher will divide the students into groups so that there are 2-3 students in 11 different groups, but each group is assigned to a Shape in the Prism section of the Shapes App
- In their groups, the students use the nets creator mode to print out their prisms Once they print out their assigned prisms on paper they take the appropriate measurements to calculate the volume of that object Next the students build the shape in 3d
- Then they find the mass of their shape by weighing it on the triple beam balance Then based upon the mass and the volume of the 3d Prisms the students will use this information to create a screencast in which they calculate the density of the prisms
- The students create a QR Code that they link to their screencast/video
- The students glue the QR Code onto their 3d figure

The students take turns going around to the 11 stations, taking measurement of the prisms, filling out the worksheet below, weighing the prisms, and then they use that information to calculate the density of each object

Then the students scan the QR Codes and use the screencasts created by their peers to check the work.

Activity Ten Worksheet

Name of the Prism	Formula for Volume of the Prism	Volume of the Prism	Mass of the 3d Prism	Density of the Prism	Did Our Density Calculations Match Our Peers? Why or Why Not?
Cube					
Hexagonal Prism					
Pentagonal Prism					
Right Trapezoidal Prism					
Triangular Prism					
Trapezoidal Prism					
Parallelepiped					

Rhombic Prism					
Isosceles triangular prism					
Right triangular prism					
Quadrilateral Prism					