Grade Level/Course: Grade 6
Lesson/Unit Plan Name: Platonic Solids — Using geometric nets to explore Platonic solids and discovering Euler's formula.
Rationale/Lesson Abstract: An activity where the students use nets to explore surface area, and the terms vertices, sides and faces.
Timeframe: 1 – 2 class periods
Common Core Standard(s): **6.G.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.

Instructional Resources/Materials:

- Cube nets – included at the end of this lesson plan.
- History Information – included at the end of this lesson plan.
- Platonic solid net masters – included at the end of this lesson plan.
- 3d printed Platonic solid nets. The stl files for the 3d printed Platonic solid nets are located on the Fab Lab website: http://www.wccusd.net/Page/5262
- Platonic Solids Pattern (i.e., Euler's Formula) worksheet – included at the end of this lesson plan.

Activity/Lesson:

Day 1:

1. Ask students to define the terms: faces, edges, and vertices:

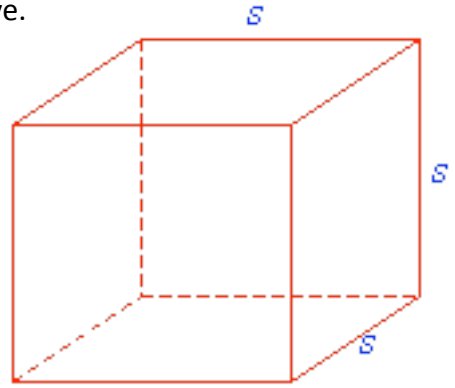
   A vertex is a corner. A **vertex** (plural: **vertices**) is a point where two or more straight lines meet.

   An edge joins one vertex with another. An edge is a line segment that joins two vertices.

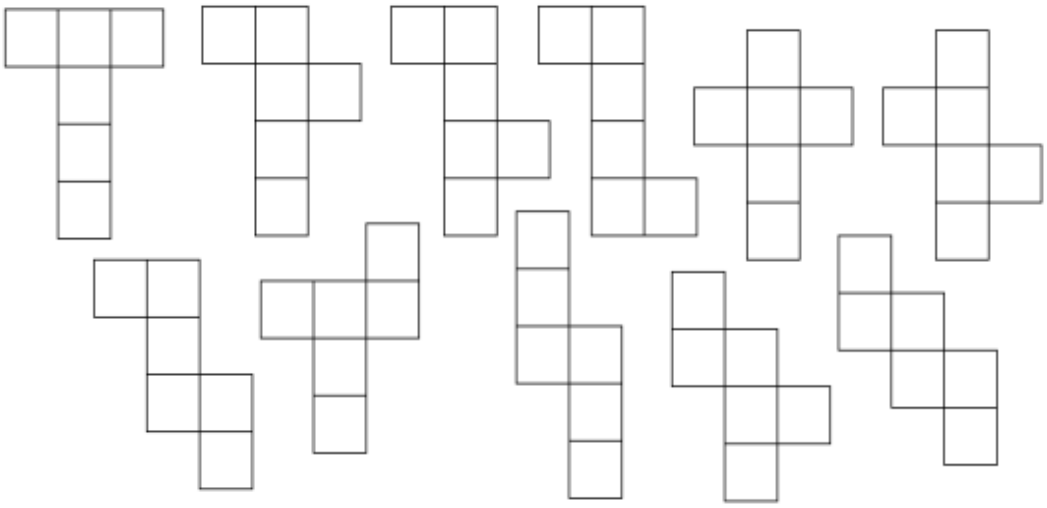
   A face is an individual surface. A face is any of the individual surfaces of a solid object.

2. Define Geometric Net: A geometric net is a 2-dimensional shape that can be folded to form a 3-dimensional shape or a solid. Or a net is a pattern made when the surface of a three-dimensional figure is laid out flat showing each face of the figure. A solid may have different nets. Nets are helpful when we need to find the surface area of the solids.

3. Review with students what a cube is and ask them how many faces, edges, and vertices does a cube have.



4. Hand out the cube nets and ask students to cut them out, fold along the lines and see if they can make a cube out of all of the nets. Note: there are only 11 nets for a cube shown below.



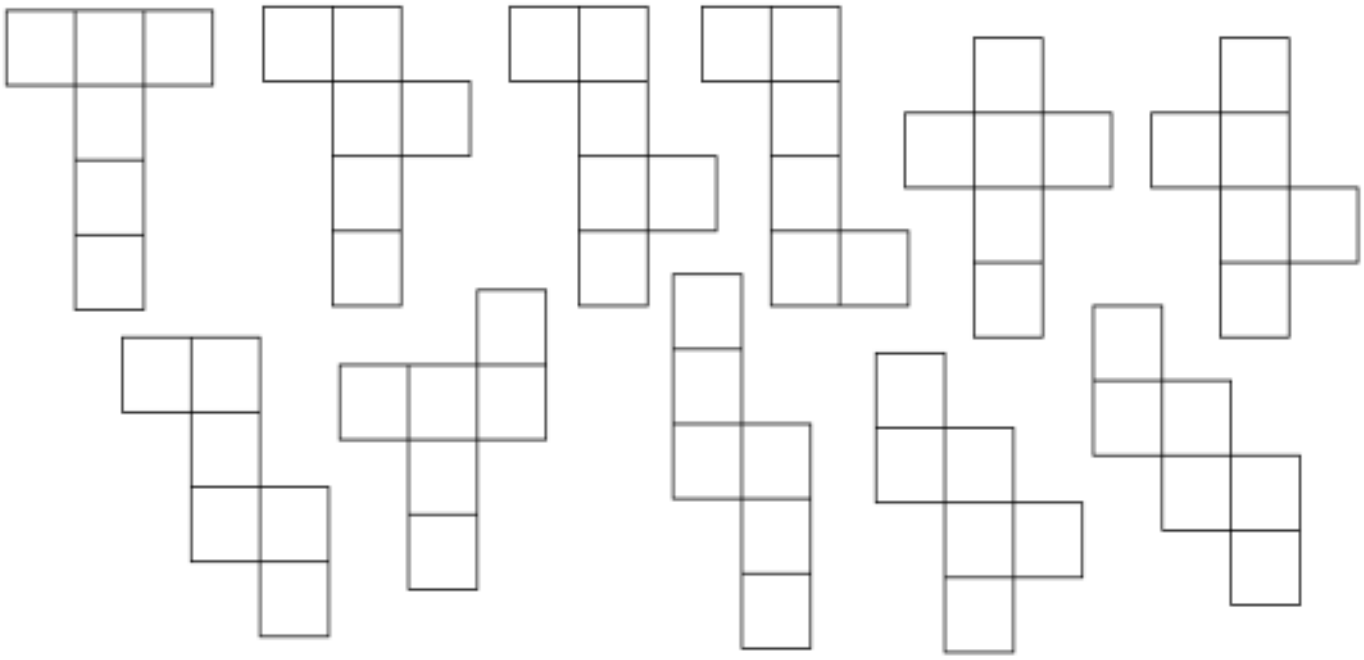
The website below is an activity where students click on a net, answer if they think it can make a cube, and watch the animation to determine if they are correct. It is a great extension to this lesson.

https://illuminations.nctm.org/activity.aspx?id=3544

Day 2:

5. Explain to students that today they will learn about Platonic Solids. Use the History Information pages – included at the end of this lesson plan.
    a. Define what Platonic solids are
    b. Share history of Platonic solids
6. Now that students understand the terms faces, edges, vertices, nets, and Platonic solids, hand out the Platonic Solids Patterns worksheet. Complete the second row, about a cube, with students.
7. Hand out the Platonic Solids Patterns worksheet and models. You can use the 3d printed Platonic Solids models or the included Platonic Solid Net masters for this part of the lesson. Using the models, in groups, students complete the Platonic Solids Patterns worksheet.
8. Using the models (3d printed or constructed models), review the answers to the Platonic Solids Patterns worksheet.
9. Tell students that a famous mathematician, Euler, discovered the formula $F + V - E = 2$ for Platonic solids using models – just like they have done.

Assessment:
You can use the Platonic Solids Patterns worksheet as the assessment of student understanding of this lesson.



History Information Pages

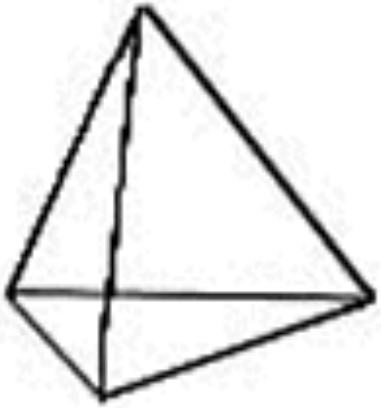
Philip Gonsalves

What is a Platonic Solid?

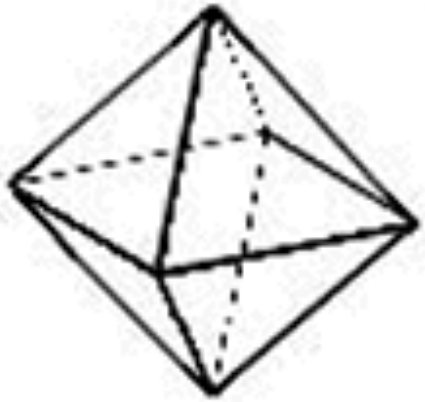
In three-dimensional space, a **Platonic solid** is made by using polygons (triangles and squares) congruent regular polygonal faces with the same number of faces meeting at each vertex. Only five solids meet those criteria, and each is named after its number of faces.

Philip Gonsalves

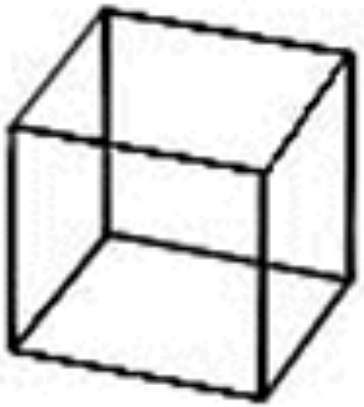
The Platonic Solids — There are only 5 of them.



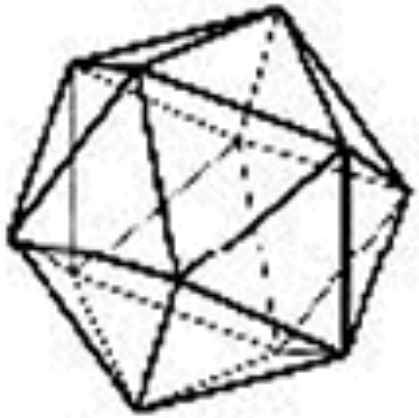
Tetrahedron



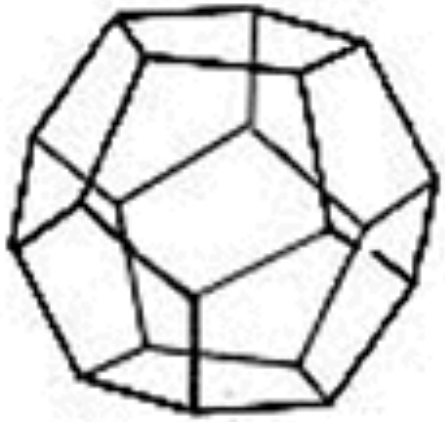
Octahedron



Cube



Icosahedron



Dodecahedron

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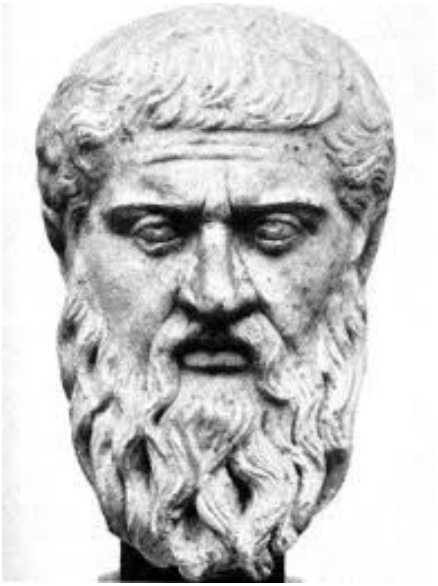
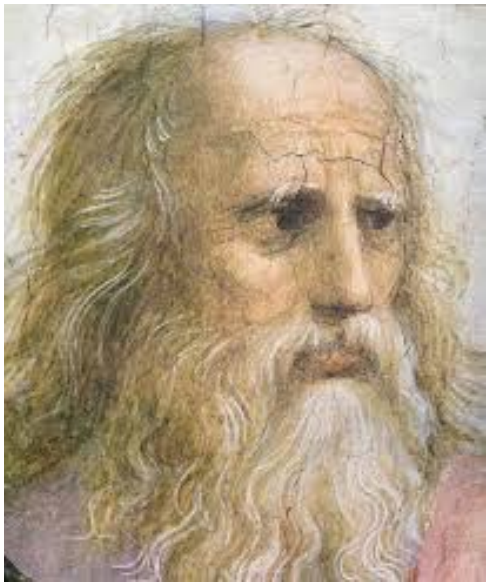
The Greek philosopher Plato, who was born around 430 B.C., wrote about these five solids in a work called *Timaeus*.

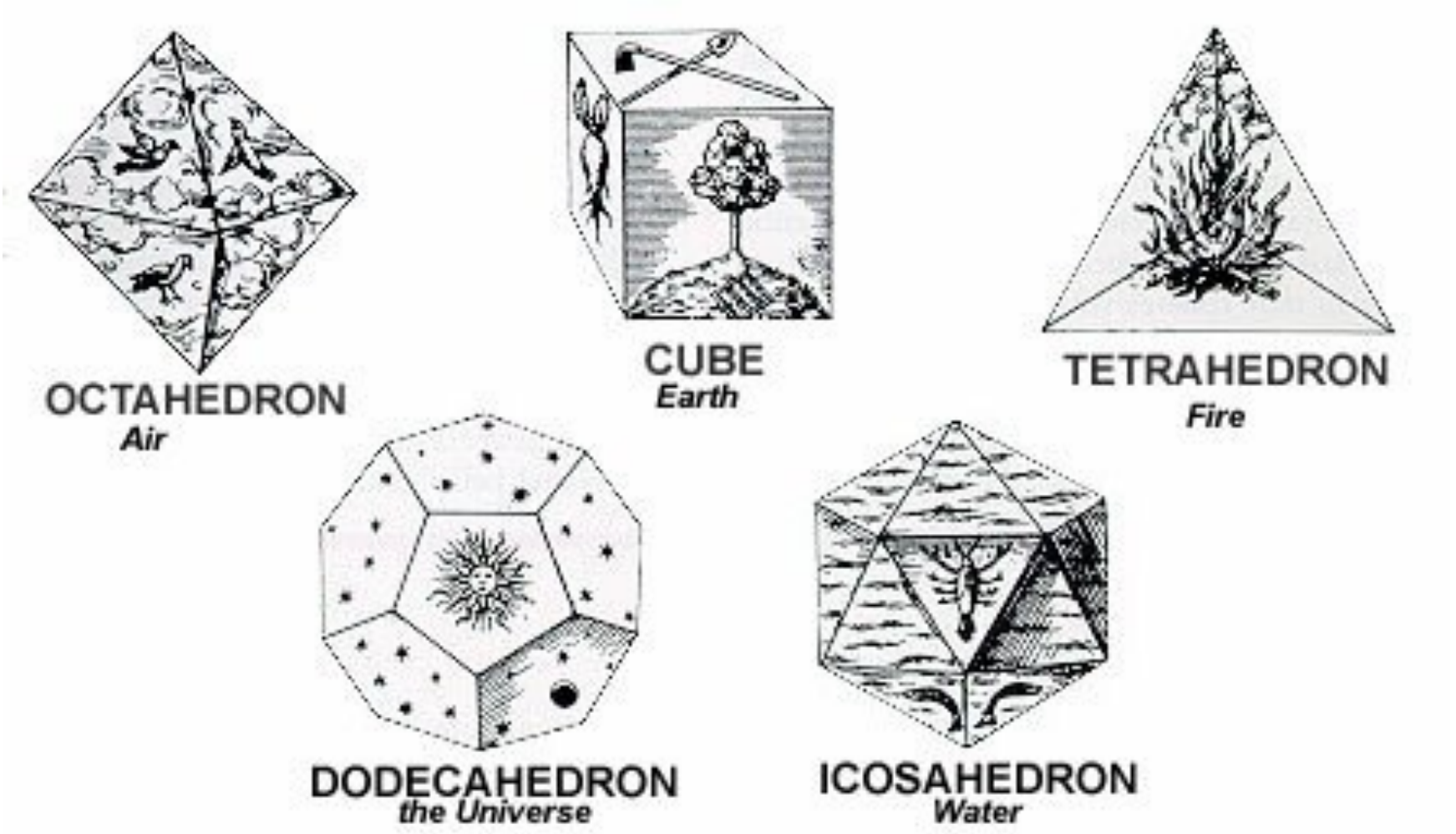




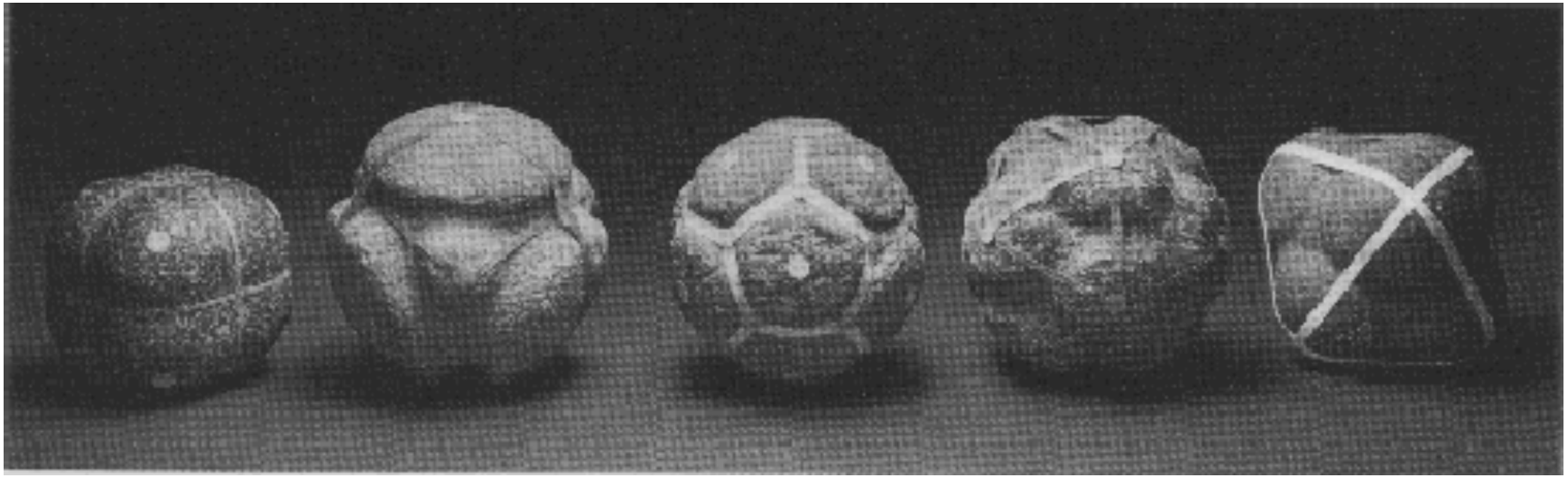
The Platonic solids themselves were discovered by the early Pythagoreans, perhaps by 450 B.C. There is evidence that the Egyptians knew about at least three of the solids; their work influenced the Pythagoreans.

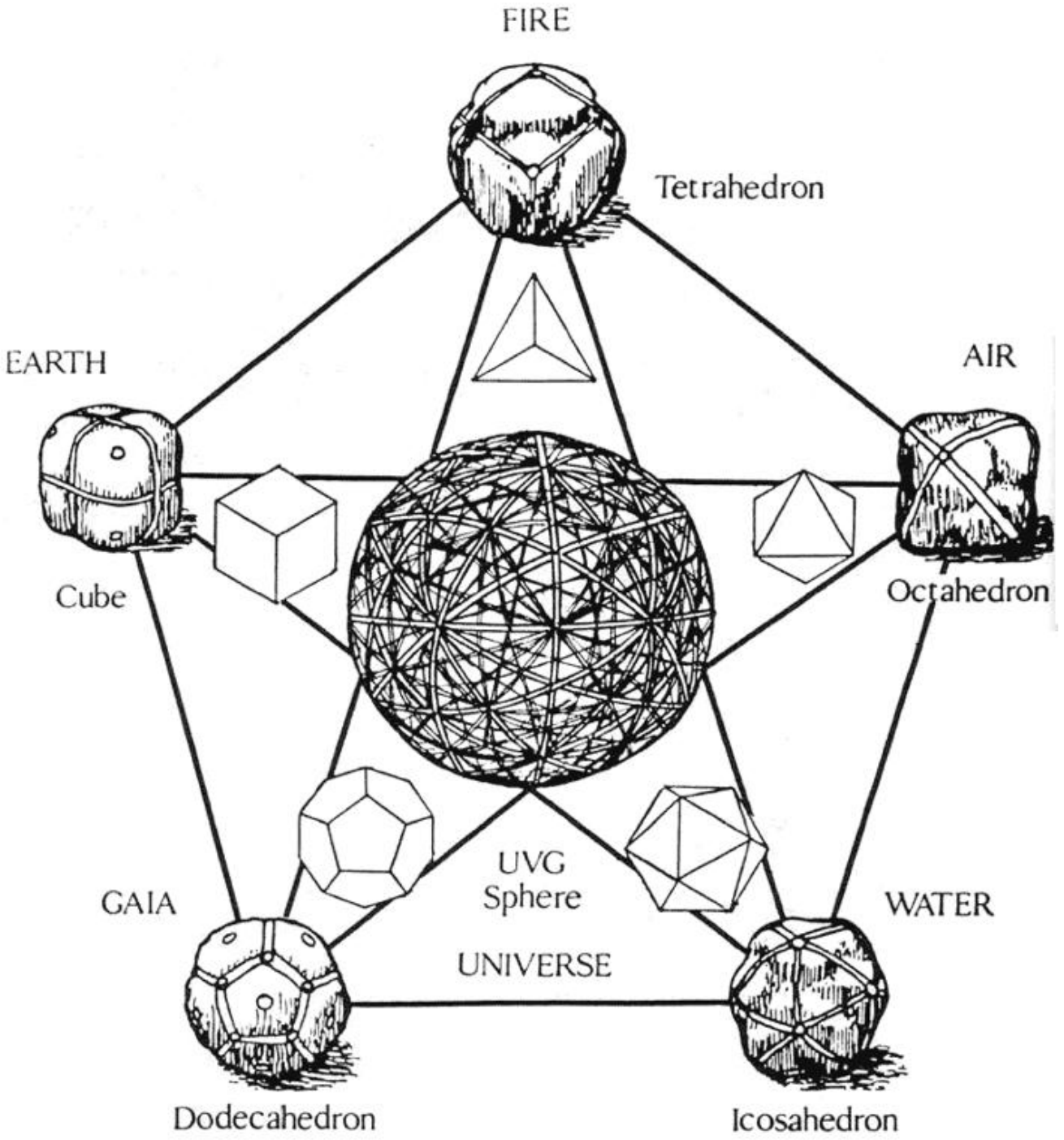
The Platonic solids were known to the ancient Greeks, and were described by Plato. In this work, Plato equated the **tetrahedron** with the "element" **fire**, the **cube** with **earth**, the **icosahedron** with **water**, the **octahedron** with **air**, and the **dodecahedron** with the stuff of which the **constellations and heavens** were made (Cromwell 1997).

Plato mentioned these solids in writing, and it was he who identified the solids with the elements commonly believed to make up all matter in the universe.



Back in history, they didn't have plastic and made mathematical models out of rocks. Below are samples of the Platonic solids that were made out of rocks.





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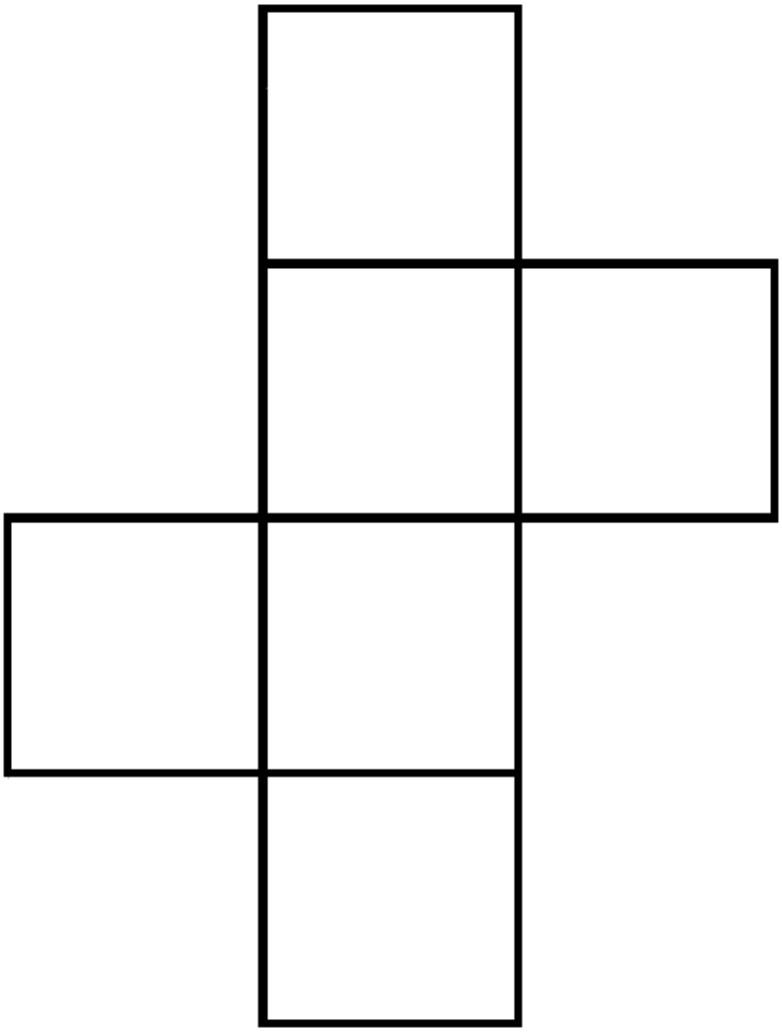
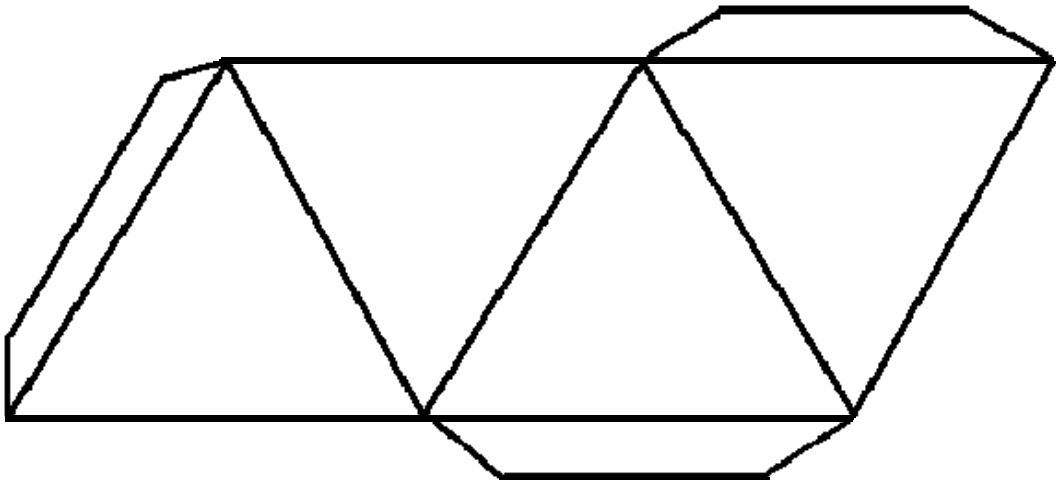
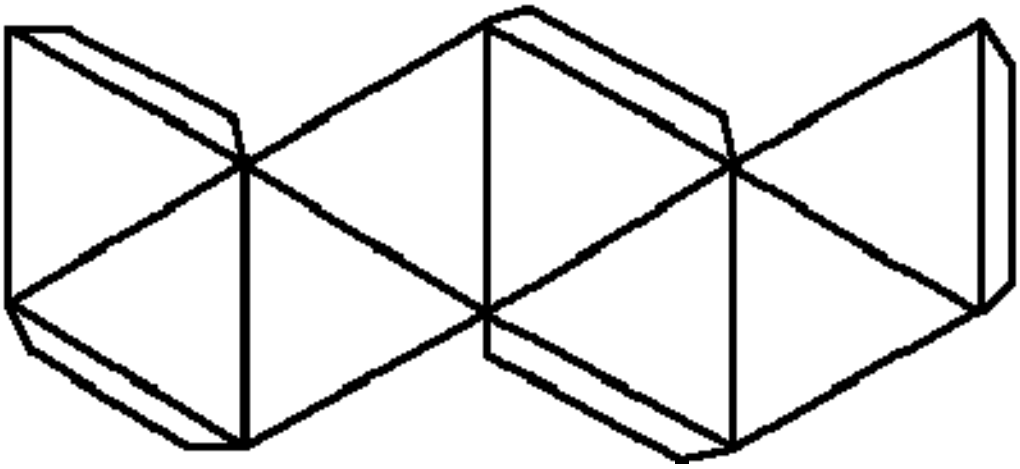
Cube



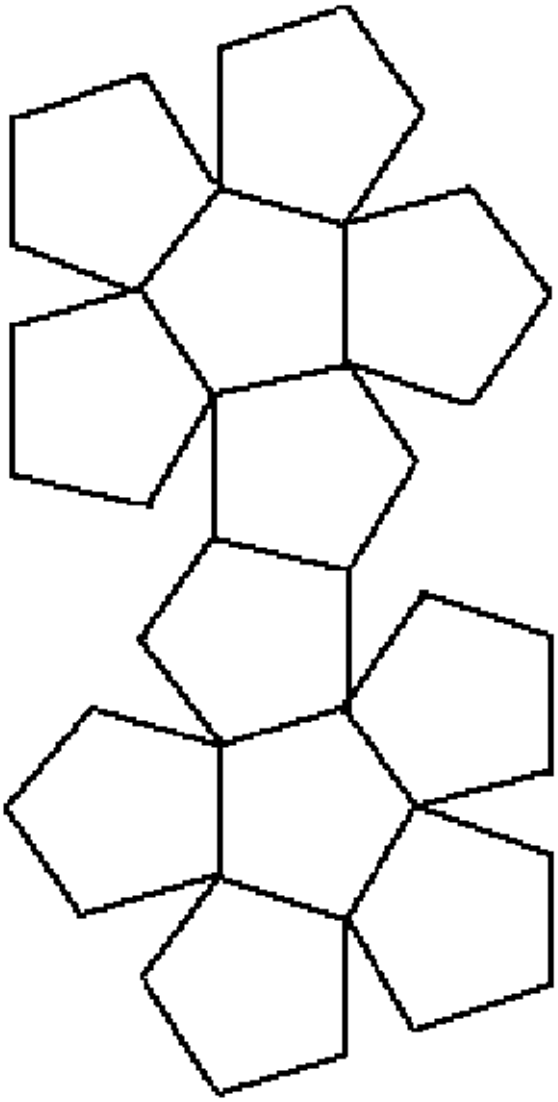
Tetrahedron



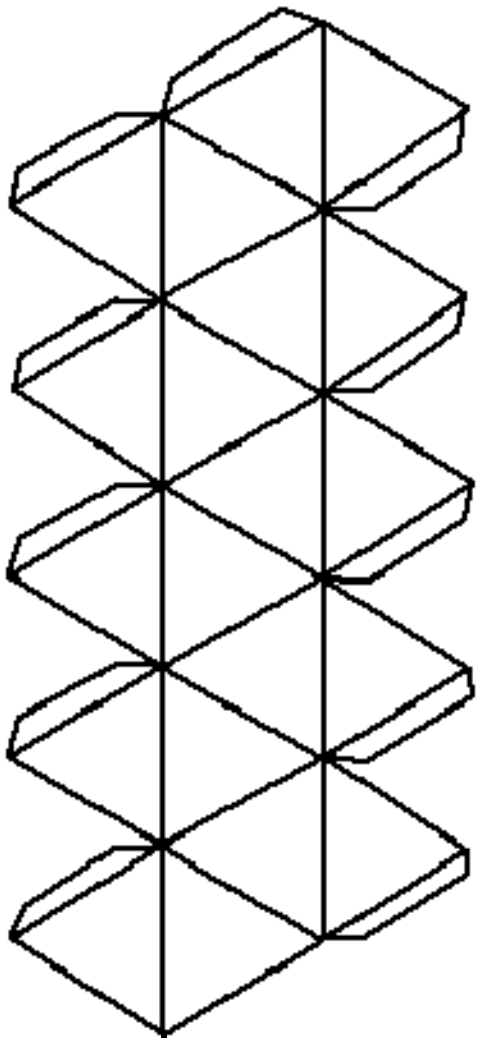
Octahedron



Dodecahedron



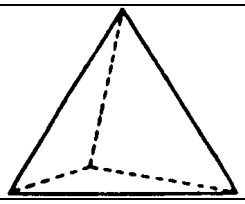
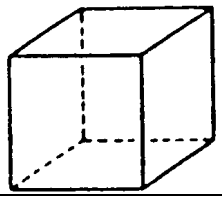
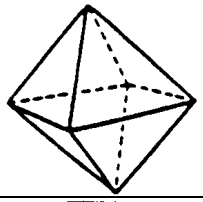
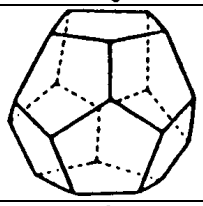
Icosahedron



Name:_____ Date:_____ Period:_____

Platonic Solids Patterns

Count and record the number of faces (F), vertices (V), and edges (E) for each of the Platonic Solids. Then calculate the values for $F+V-E$.

Name	**Figure**	**Faces** (F)	**Vertices** (V)	**Edges** (E)	**F + V– E**
Tetrahedron					
Hexahedron (cube)					
Octahedron					
Dodecahedron					
Icosahedron