

Designing a Geocity

Brief Overview:

The unit, “Designing a Geocity,” allows students to explore the essential properties and relationships of two-dimensional and three-dimensional figures using models. Students will use prior knowledge to compare and contrast two and three-dimensional figures. Students will have the opportunity to use geometric manipulatives and tools to create two-dimensional blueprints and to use those blueprints to design and construct model towns.

NCTM Content Standard/National Science Education Standard:

Content Standards:

- Through building, drawing, and analyzing two-dimensional shapes, students understand attributes and properties of two-dimensional space and the use of those attributes and properties in solving problems.
- Students extend and deepen their understanding of properties of two-dimensional shapes.
- Students analyze characteristics and properties of two- and three-dimensional geometric shapes and develop mathematical arguments about geometric relationships.
- Students use visualization, spatial reasoning, and geometric modeling to solve problems.

Processes Standards:

Problem Solving, Reasoning and Proof, Communications, Connections, Representation

Grade/Level:

Grade 3 and Grade 4

Duration/Length:

Six 60-minute lessons, 1 60-minute assessment day

Student Outcomes:

Students will...

- Analyze the properties of plane geometric figures
- Identify and describe cubes, rectangular prisms, and triangular prisms
- Identify or describe polygons
- Identify or describe quadrilaterals
- Identify triangles, rectangles, or squares as part of a composite figure
- Use triangles, quadrilaterals, pentagons, hexagons, or octagons and the number of sides or vertices
- Compare a plane figure to surfaces of solid geometric figures

- Analyze the properties of solid geometric figures
- Identify and describe cubes, rectangular prisms, and triangular prisms.
- Identify cones, cylinders, prisms, and pyramids
- Analyze the relationship between plane geometric figures and surfaces of solid geometric figures

Materials and Resources:

<p style="text-align: center;">Lesson 1</p> <p>Overhead Geoboard Overhead Pattern blocks or shapes) Student Geoboards 1/student <i>Mummy Math: An Adventure in Geometry</i> by Cindy Neuschwander <i>Geo Sort</i> Student Resource 1 Containers of Power Solids/ mixed geometric shapes(1/group) <i>Geocity Assessment Checklist</i> Teacher Resource 1</p> <p><u>Vocabulary Development:</u> two-dimensional, triangle, square, rectangle, hexagon, angle, three-dimensional, cube, cone, rectangular prism, sphere, cylinder, pyramids</p>	<p style="text-align: center;">Lesson 2</p> <p>Students' homework journals Chart paper Markers Geometric Solids(from home and school) <i>Guess My Rule</i> Teacher Resource 2 <i>Venn Diagram</i> Student Resource 2 <i>Describing Geometric Solids</i> Student Resource Form #3 <i>Guess My Rule</i> Student Resource Card Game #4 <i>Geometric Vocabulary Foldable</i> Student Resource 5</p> <p><u>Vocabulary Development:</u> vertices, edges, faces, line segments</p>
<p style="text-align: center;">Lesson 3</p> <p><i>Cubes, Cones, Cylinders and Spheres</i> by Tana Hoban Tape 1/group Scissors – 1/student 2-inch grid paper Student Resource 6 Math Journals <i>Nets of Cubes</i> Teacher Resource 3</p> <p><u>Vocabulary Development:</u> net</p>	<p style="text-align: center;">Lesson 4</p> <p><i>Cubes, Cones, Cylinders and Spheres</i> by Tana Hoban <i>1 set of nets</i> Student Resource 7-11 Tape 1/group Scissors – 1/student Markers- 1 set/group 2-inch grid paper Geometric Body Suits Teacher Resource 4</p> <p><u>Vocabulary Development:</u> nets</p>
<p style="text-align: center;">Lesson 5</p> <p>Blueprint Construction paper Ditto paper Scissors Glue Tape Crayons</p>	<p style="text-align: center;">Lesson 6</p> <p><i>Constructing a Geocity Group Presentations</i> Student Resource 14 www.youtube.com/watch?v=jCHwHG6RCeE (Second Life-Building a City from National Mapping Data) www.youtube.com/watch?v=HPb8q8535C</p>

<p>Markers rulers <i>A Description of My Geostructure</i> Student Resource 12 <i>Blueprint of My Geostructure</i> Criteria Student Resource 13</p> <p>Vocabulary Development: Architect Blueprint</p>	<p>Q&NR=1 (Building a City from Scratch) Construction paper Ditto paper Scissors Glue Tape Crayons Markers Rulers Poster Boards (for setting up cities)</p> <p>Vocabulary Development: Construction engineer</p>
<p>Lesson 7-Assessment Day <i>Geocity Summative Assessment</i>(Teacher Resource 5)-1/student <i>Geocity Presentation Scoring Tool</i> Student Resource 13 1/student</p>	

Development/Procedures:

Lesson 1: GEOSORT!

Objective: Students will be able to analyze properties of geometric figures.

Pre-assessment

- To tap into students’ prior knowledge, students will work independently to construct plane figures using geoboards.
- Call the names of six 2-dimensional geometric figures (triangle, square, rectangle, hexagon, trapezoid, and octagon) and students will make them on the geoboards.

Launch

- Students will be told that they will be studying 2 different types of geometric figures (planes and solids) so that they can construct geocities which are geometric models of towns.
- Read the book *Mummy Math: An Adventure in Geometry* by Cindy Neuschwander to the students. Before reading, tell the students, “As we read, listen for the names and descriptions of solid figures.”
- Students will participate in a “Geometric Picture Walk” where they will view and identify pictures of solid figures.
- Students will add new vocabulary to the class “word wall.”

Teacher Facilitation

Each group will be given a container of “Power Solids” to explore. (Power solids include spheres, cubes, rectangular prisms, pyramids, cones, cylinders).

Mathematics Questions:

- What do all of these figures have in common?
- How are they different from plane figures?
- How are plane figures and solid figures related?

Student Application

- Students will receive containers of mixed geometric shapes (planes and solids). They will work cooperatively on a “GeoSort” activity. They will sort and justify reasons for categorizing shapes into two categories: plane or solid figures. See Student Resource 1.
- Students will identify and label the geometric plane and solid figures at the top of the worksheet.

Embedded Assessment

- Use a geometric shapes checklist to assess students’ progress (*Geocity Assessment Checklist* Teacher Resource 1).
- Students will be monitored for participation, cooperation and work habits.

Reteaching/Extension

Homework:

- Tell students to look around their neighborhoods and homes and identify as many different 3-D shapes as they can. (Example- A basketball is shaped like a sphere.) Students should record their findings in their math journals.
- Say: *In preparation for building geocities*, look in magazines on the Internet, or take pictures as you walk home, or draw examples of pictures of buildings you would see in a cityscape.

Lesson 2: Describing Geosolids!

Objective: Students will be able to identify the number of faces, edges, and vertices of solid figures, and the shape of each face

Pre-assessment

Students and teacher will share homework findings. Teacher will create a chart of the names of the geometric objects and the shapes that students observed in their homes or in their neighborhoods (For example, “a television is shaped like a rectangular prism”).

Launch

Display an example of each geometric solid.

- For example an empty tissue box could be used to represent a cube,

- a ball to represent a sphere
- a soup can to represent a cylinder
- a cone to represent a cone
- a cereal box to represent a rectangular prism and a
- a toy pyramid to represent a pyramid.

Vocabulary Development/Review- Students will identify and describe the 3-dimensional geometric shapes.

Teacher Facilitation

- Give each group a Venn Diagram and 2 solid shapes. Students will work cooperatively to compare and contrast the two shapes. (See Student Resource 2.)
- Vocabulary development will be reinforced.

Mathematics Questions:

- Describe student observations.
- Challenge students to name the similarities and differences between the shapes.
- Introduce new mathematical terms, faces, edges, vertices, line segments.
- Use models to demonstrate new vocabulary.

Student Application

- Material managers will distribute geometric solids to each group.
- Material managers will distribute a ‘*Describing Geometric Solids*’ Student Resource Form #3 to students.
- Students will work cooperatively to describe the number of faces, vertices and edges; shapes of the faces and a real world example for each geometric shape.
- Students will add new vocabulary to the class “word wall.”

Embedded Assessment

- Each group will be given a copy of the game, “*Guess My Rule*” Student Resource 4. Students will match solid geometric names with the clues. Answer key can be found on Teacher Resource 4.

Reteaching/Extension

Homework:

- Give directions for the geometric foldable. Students will complete the *Geometric Vocabulary Foldable* Student Resource 5 for homework.
- Look in magazines; look on the Internet, take pictures as you walk home, draw examples, and bring pictures of buildings you would see in a cityscape.

Directions: (Look at models)

1. Cut out the rectangle.
2. Turn paper over and write your name.

3. Turn over and fold on the center solid line.
4. Cut each dotted line to the fold (to make flaps). You now have five flaps!
5. On the outside of each flap write the name of a geometric solid (use the vocabulary wall) and draw the matching picture.
6. Under each flap, write at least two (2) characteristics of each geometric solid.

Lesson 3 *Building a Cube*

Objective: *Students will be able to work cooperatively to find multiple ways (nets) to construct cubes.*

Pre-assessment - Mystery Shape

Read the rules to students. “Today we will play a game called ‘*Mystery Shape*.’” I will begin by drawing the solids on the board. Raise your hand once you know the name of the solid that I am drawing.” Begin drawing a solid. Stop occasionally to call on students. When a student guesses correctly, the teacher finishes the solid shape. The class discusses characteristics of the shape. Repeat procedure for each shape.

Launch

- Tape a cube on the board and ask students to describe the attributes of the cube. Record notes on the boards while students record notes in their journals.
- Students will look around the classroom and identify objects that are shaped like a cube. Record notes on the board.

Attributes of A Cube	Objects Shaped Like A Cube

Teacher Facilitation:

- Read excerpts from the book Cubes, Cones, Cylinders and Spheres by Tana Hoban.
- Using pictures from the book, illicit responses from the students concerning ways to build a cube from a piece of 2-inch grid paper, Student Resource Sheet 6.
- Introduces the vocabulary term, net
- Have students discuss ways to build a net for a cube.

Mathematics Questions:

- If your group were to build a cube, how many 2-inch squares would you use and why?
- Explain why the net of the cube is important in building a cube.
- Is there any special configuration that you would use to build your cube?

Student Application:

- Student material managers gather supplies.
- Students work cooperatively to construct different nets that would make a cube.
- Students construct a table and record findings.

Drawing of Net	Results- Looks Like a Cube when taped together! Yes/No

- Students build shapes by cutting and taping nets.

Embedded Assessment:

- Students record findings in their journals.
- Monitor and observe students for correct drawings of nets. Use *Assessment Checklist* Teacher Resource 1.
- Students will add new vocabulary to the class “word wall.”
- Cooperative groups will share configurations of nets that made cubes.
- Students will generalize about which net configurations can be constructed into a cube.
- Share the answers for the 11 nets that form cubes, *Nets of Cubes* Teacher Resource 3.

Reteaching/Extension

Homework:

- Tomorrow students will construct nets for the other geometric solids. Each group will be given a specific geometric solid to think about. Students will predict how the net for that geometric solid would look . Instruct students to draw a diagram of that net in their journals.
- Tell students to continue looking in magazines and on the Internet for pictures of buildings they would see in a cityscape. Bring in samples.

Lesson 4 *Geometric Body Suits*

Objective: *Students will be able to describe attributes and construct nets for geometric solids (pyramid, rectangular prism, cone, and cylinder).*

Pre-assessment – Geometric Body Suits

- Continue reading the book Cubes, Cones, Cylinders and Spheres by Tana Hoban.
- Have students discuss the attributes of each solid in relation to how each net will look. (Example A cylinder has 2 round faces so the net should have 2 circles.)

- Relate nets to “body suits”. Have students to visualize a net being a suit that would fit completely around a solid (Distribute ‘*Geocity Body Suits*’ Teacher Resource 4).

Launch

- Show a geometric solid and have students share their homework by describing the corresponding net.
- Write student-predictions on the *Geometric Body Suits* Teacher Resource 4. (Teacher should make an overhead or a large chart paper).

Teacher Facilitation

- Post and review the chart “*Geometric Body Suits*” Teacher Resource 4.
- Read directions for constructing nets.

Student Application

- Materials Manager will distribute geometric nets (Student Resource Sheets 7-11) to students.
- Students will work cooperatively to construct their nets.
- Students will review class “word wall.”
- Students will display nets in class.
- Use the Smartboard to review the geometric nets and the matching solids. (The Smartboard program can be used to open and close nets to form solids.)

Embedded Assessment:

- Monitor and observe students as they draw nets. Use Assessment Checklist Teacher Resource 1.

Reteaching/Extension:

Extension (If time allows)

- Students will be given a folder with pictures from the city. Students will identify solid shapes in the pictures.

Homework:

- Have students look in magazines, look on the Internet, take pictures as they walk home, draw examples, and bring in pictures of buildings they would see in a cityscape.

Lesson 5 –*Designing a Blueprint of a Geocity*

Objective: Students will be able to work cooperatively and use geometric nets to create blueprints of structures found in a city.

Pre-assessment - Brainstorm Structures

- Students will work cooperatively and brainstorm careers related to building a geocity. Tell students that they will become junior architects for the day and will design their own structures.

Launch

- Students will share homework pictures of buildings found in a city (churches, museums, houses, apartment buildings, stores, schools, sports complex, movie theaters, government buildings, etc.
- Students will brainstorm names of more buildings found in a cityscape.
- Students will observe blueprints of structures and will match 2-D blueprints with corresponding structures.
- Students will decide on 5 structures that they would like to see in their “geocity.”

Teacher Facilitation

- Introduce the idea of students becoming junior architects and of using a blueprint to design their cities.

Mathematics Questions:

- What are the job duties of an architect?
- What shapes do architects use to build structures? Are these shapes 2-D or 3-D?
- How do we construct buildings for our cities that are 3-dimensional?
- Explain why it is important for an architect to make a blueprint.
- Explain how geometric nets are similar to blueprints.
- What would a net of your school look like? What would a net of a church look like?
- Introduce the criteria that will be used to score the blueprints (*Blueprint of My Geostructure Criteria* Student Resource 12).
- Introduce the task for “*A Description of My Geostructure*, Student Resource 12.

Student Application

- Students write descriptions of their geostructure. (See *A Description of My Geostructure* Student Resource 12).
- Students draw nets of their structures in their math journals.
- You will serve as a project manager and approve the students’ structure designs.
- Students create their blueprints.
- Students self-evaluate blueprints using ‘*Blueprint Criteria #13*.’

Embedded Assessment:

- Monitors and observe students for descriptive paragraphs and correct construction of 2-D blueprints.

- Use ‘*Blueprint of My Geostructure Criteria*’ Student Resource 13 and *Assessment Checklist* Teacher Resource 1 to assess students.

Homework:

- Students will complete blueprints for homework.

Reteaching/Extension:

How a House Is Built by Gail Gibbons (Optional)

Lesson 6 *Building a Geocity* (THE CONCLUSION!!)

Objective: *Students will be able to use 2-dimensional blueprints to build 3-dimensional structures.*

Pre-assessment

- Students will share their 2-dimensional blueprints with the class.
- Classmates will use mathematical vocabulary to guess the name of the geometric solid represented.

Launch

Students will watch a video of a city being built.

www.youtube.com/watch?v=jCHwHG6RCeE (Second Life-Building a City from National Mapping Data)

www.youtube.com/watch?v=HPb8q8535CQ&NR=1 (Building a City from Scratch)

Teacher Facilitation

- Review with students the scoring tool ‘*Blueprint of My Geostructure Criteria*’ Student Resource 13.

Student Application

- Students will work cooperatively and evaluate blueprints for their cities.
- Students will apply their knowledge to a real world setting by constructing geostructures for their cities.
- Students will work cooperatively and construct their geocities.
- Cooperative groups will use a graphic organizer (sequence chain) to organize the information that the group members will present.

Embedded Assessment:

- Monitor and observe students for construction of geocities. Use *Assessment Checklist* Teacher Resource 1. Teacher reminds students to use both the blueprint criteria and the presentation scoring tool as they construct their geocities.

Lesson 7: Summative Assessment

Objective: Students will be able to show mastery of geometric knowledge by completing a summative assessment and a group presentation.

- Teacher will determine students' progress towards understanding the relationship between 2-dimensional and 3-dimensional geometric figures based on a 10 point formal assessment and the cooperative group's presentation on their geocities. (See *Geocity Summative Assessment* Teacher Resource 5 and *Constructing a Geocity Group Presentation* Students Resource 14).

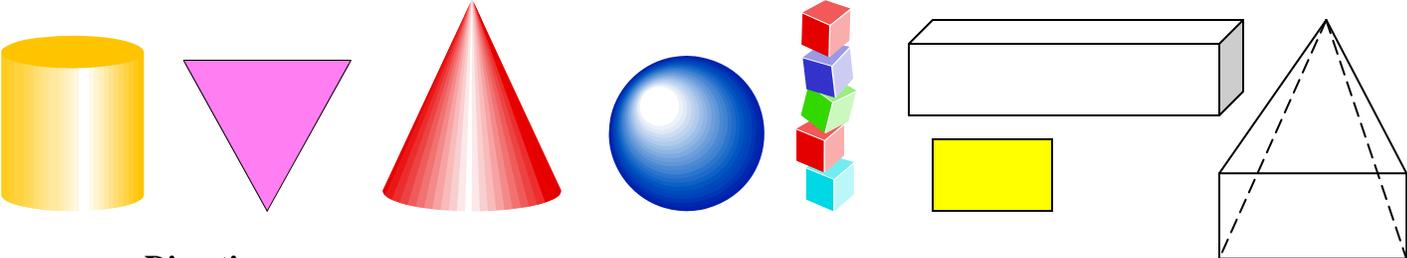
Authors:

Marian Orenstein
North Forestville Elementary School
Prince Georges County

Andrienne R. Seetorie
Bel Air Elementary School
Prince William County

Sort the Figures Activity

Student Name: _____ Date: _____

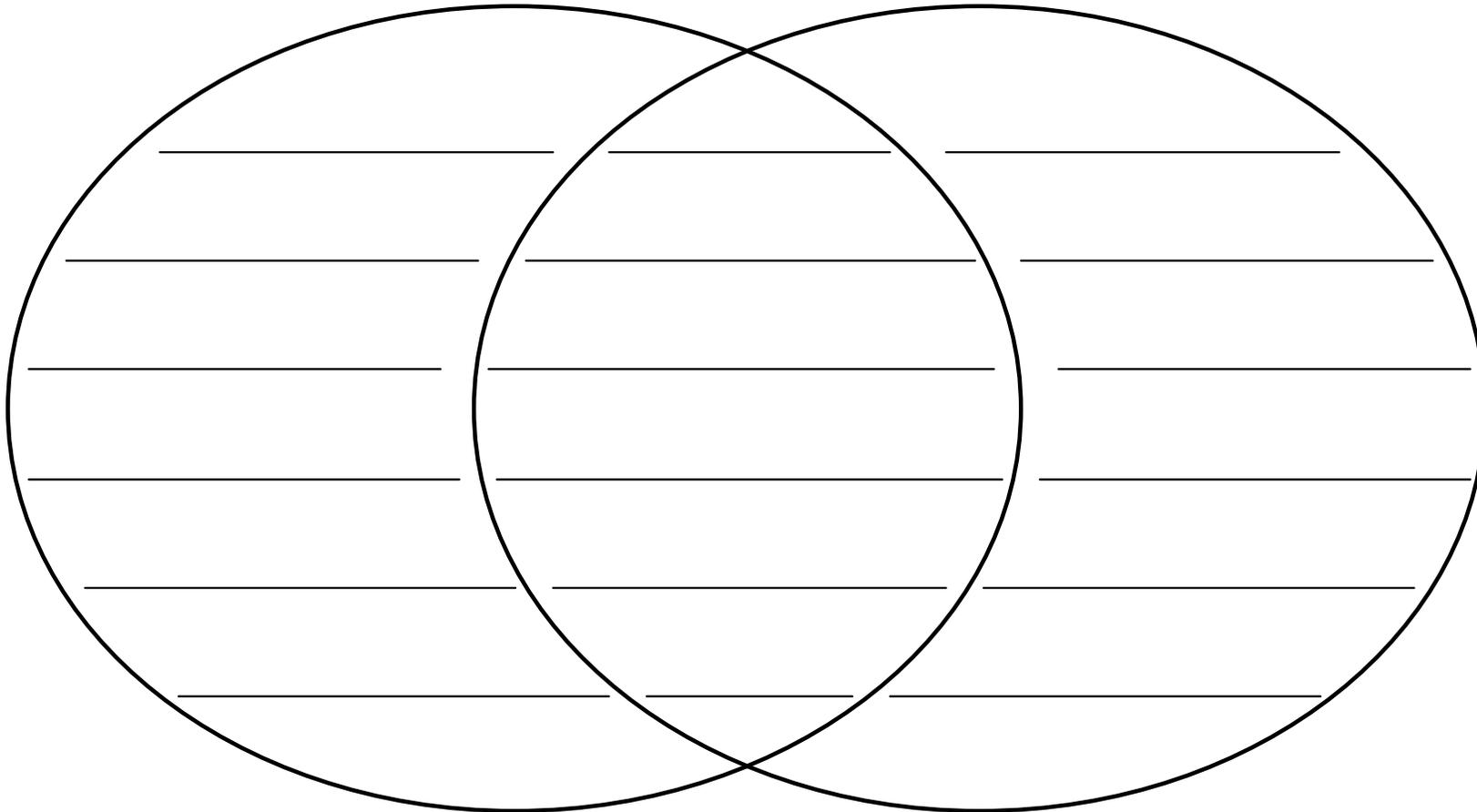


Directions:

- 1. Open your container of geometric shapes.
- 2. Work cooperatively with your group and examine the figures.
- 3. Sort the figures into 2 groups- plane or solid figures.
- 4. Draw and label the shapes on this worksheet.
- 5. Be prepared to share reasons for your results.

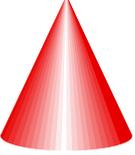
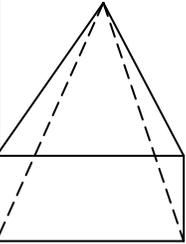
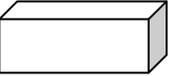
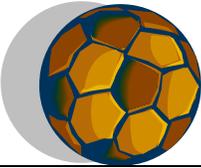
Geo Sort

Comparing and Contrasting Geosolids



Name: _____ Date: _____

Describing Geometric Solids

Picture of 3-D Figure	Name of Solid	Number of Edges	Number of Faces	Number of Vertices	Shape of Faces	Real Word Examples
						
						
						
						
						
						

Guess My Rule

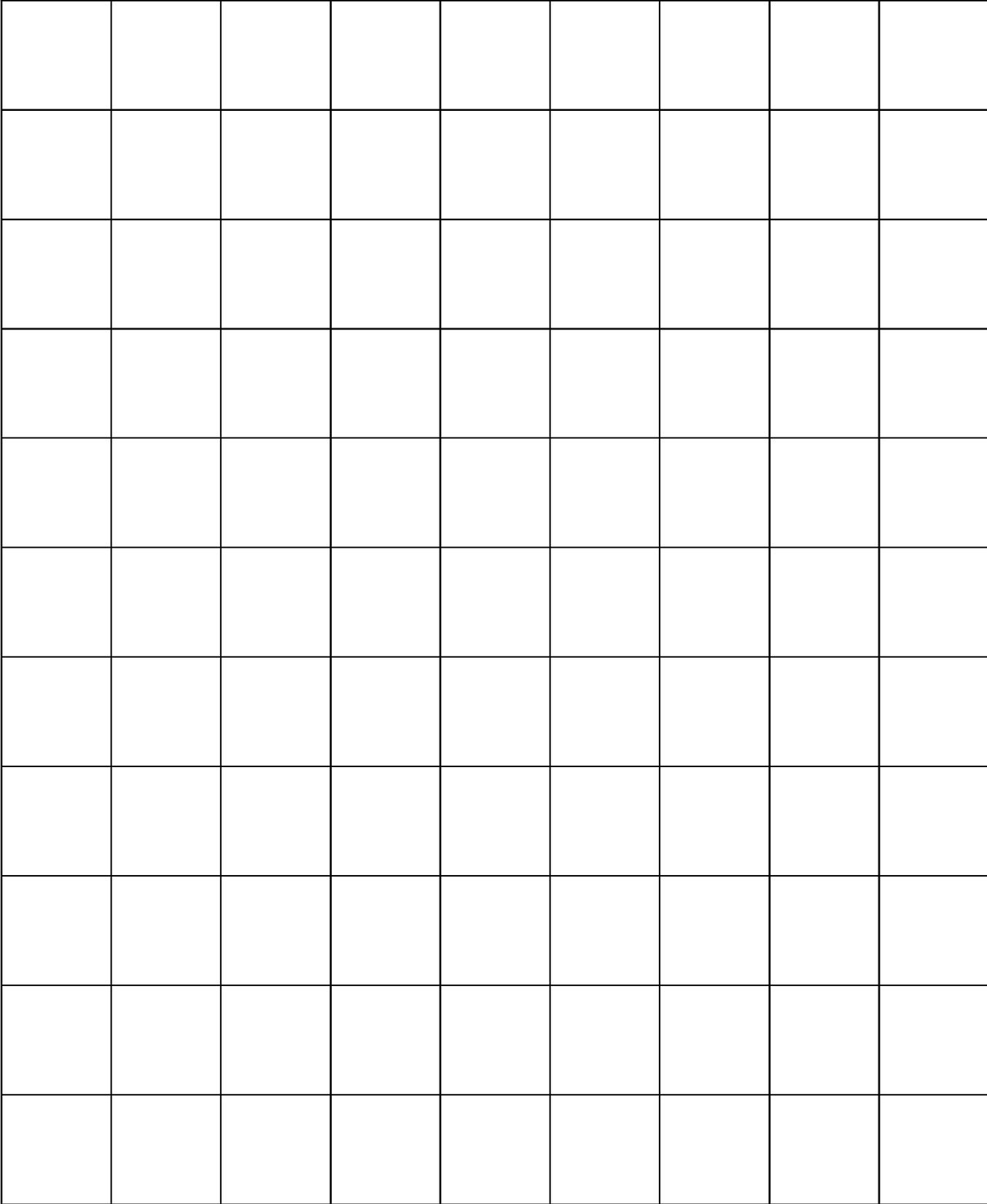
<p>I'm a solid. I have six (6) faces that are all shaped like a square. Who Am I?</p>	Cube
<p>I'm a plane figure. I have 3 sides and 3 angles. Who Am I?</p>	Triangle
<p>I have 5 sides and 5 angles. I am named like a famous building in Virginia. Who Am I?</p>	Pentagon
<p>I am a 3-dimensional figure. I have 5 sides. 4 of my faces are triangular. The other face is a square. Who Am I?</p>	Pyramid
<p>I am a solid figure shaped like a shoe box. All of my 6 faces are rectangular. Who Am I?</p>	Rectangular Prism
<p>I am a 3-dimensional shape. I have no faces. If you put me on a table, I may roll around. Who Am I?</p>	Sphere
<p>I am a plane figure. I have six sides and six angles. Who Am I?</p>	Hexagon
<p>I am a plane figure, a regular polygon. I have 4 sides. All of my sides are equal. Who Am I?</p>	Square
<p>I have 3 dimensions. One of my faces is circular. You can fill me with ice cream! Who Am I?</p>	Cone
<p>I roll. Two of my faces are circles. Who Am I?</p>	Cylinder

Student Resource Sheet #5
Geometric Vocabulary Foldable

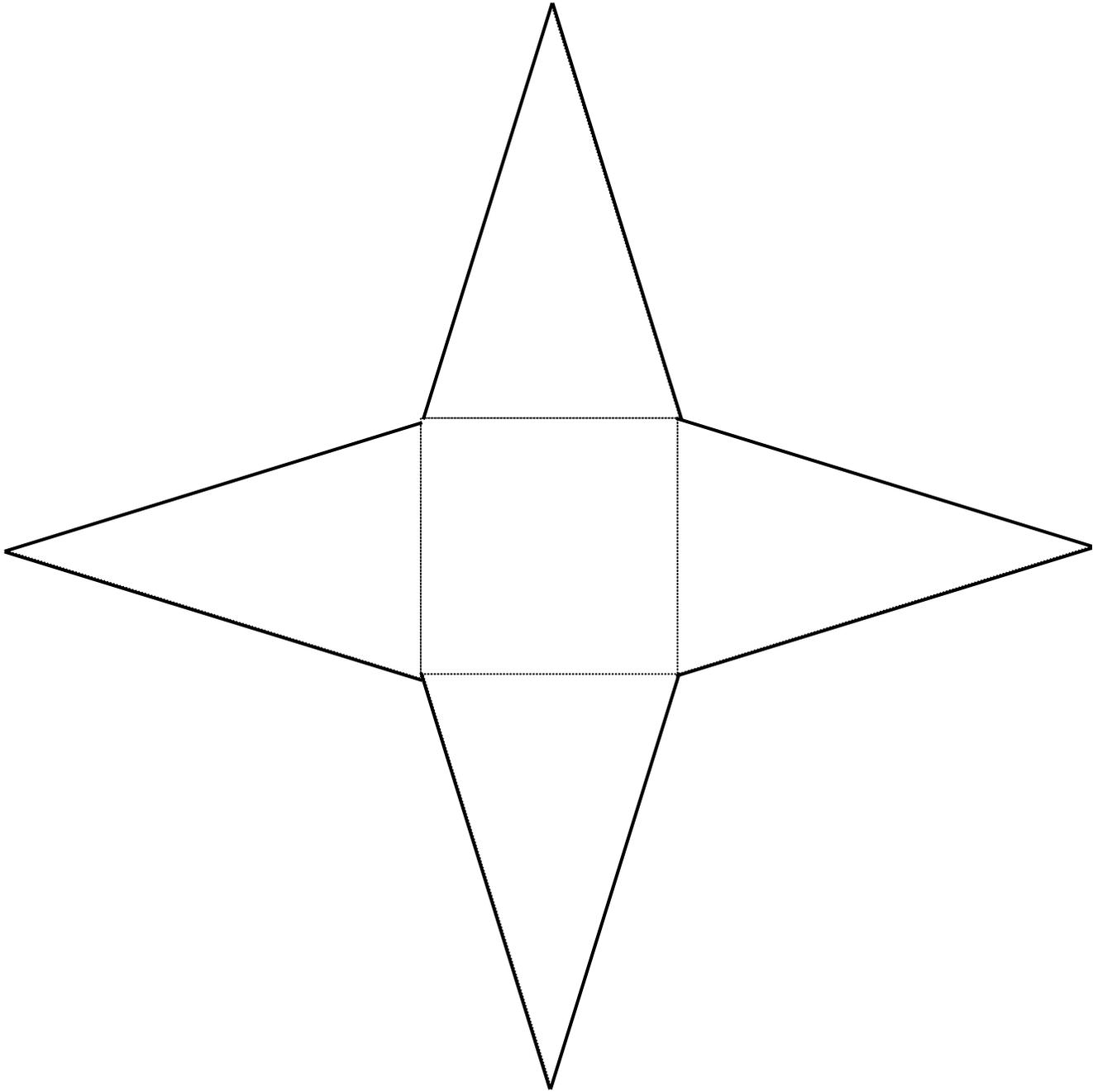
Directions: (Look at models)

1. Cut out the rectangle.
2. Turn paper on the back and write your name and today's date.
3. Turn over and fold on the center solid line.
4. Cut each dotted line to the fold (to make flaps). You now have five flaps!
5. On the outside of each flap write the name of a geometric solid (use the vocabulary wall) and draw the matching picture.
6. Under each flap, write at least two (2) characteristics of each geometric solid.

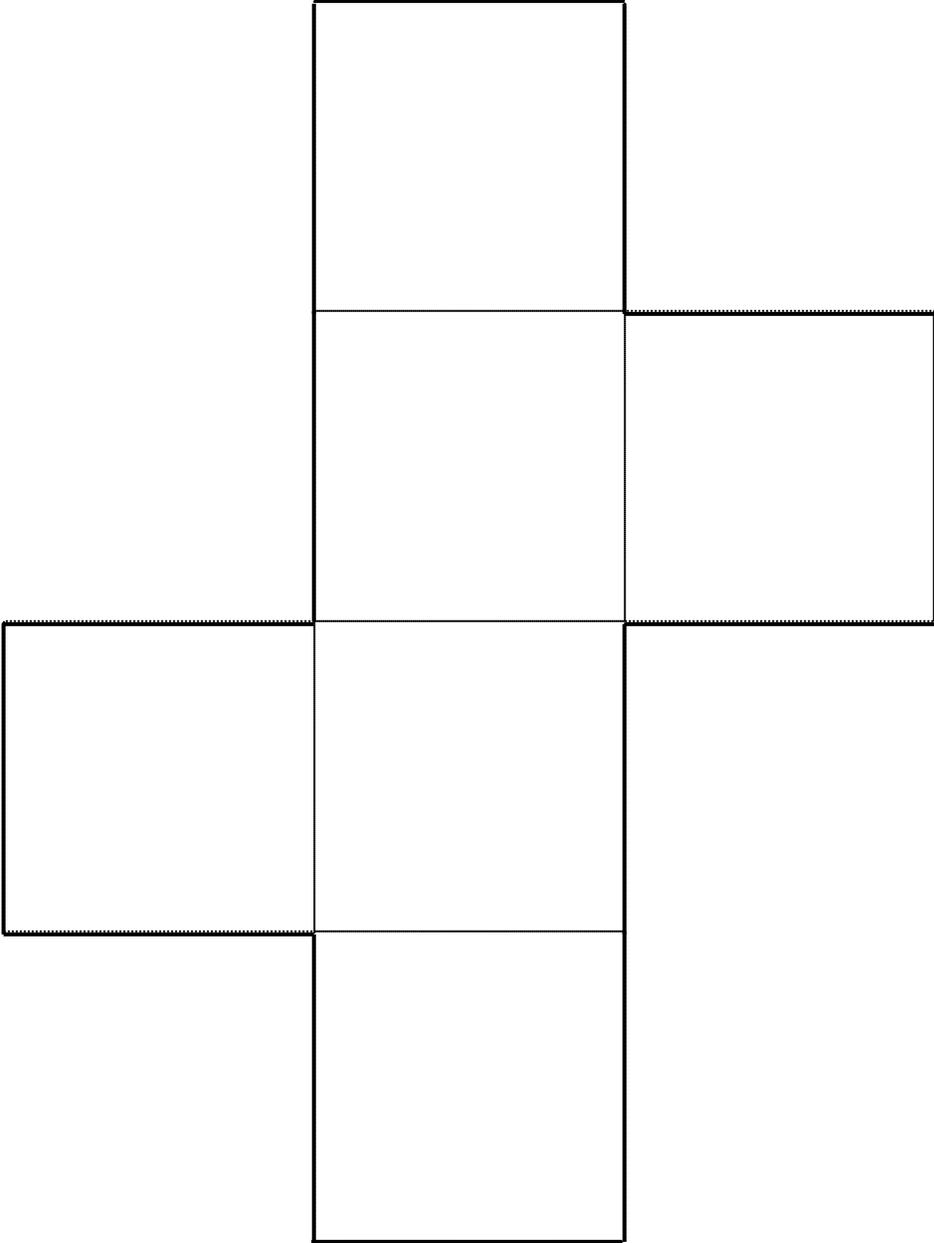
Two-Centimeter Grid Paper



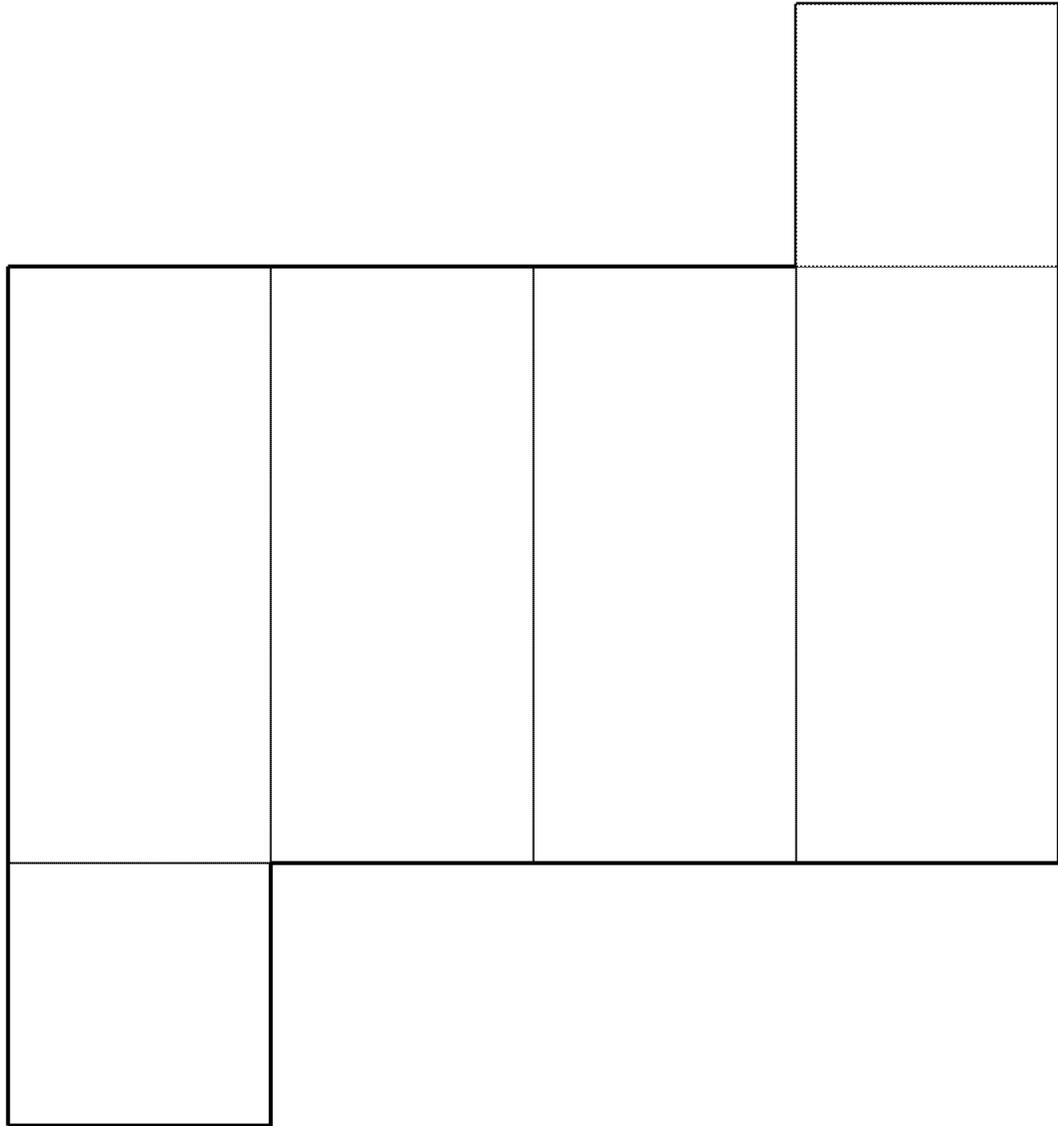
Pyramid



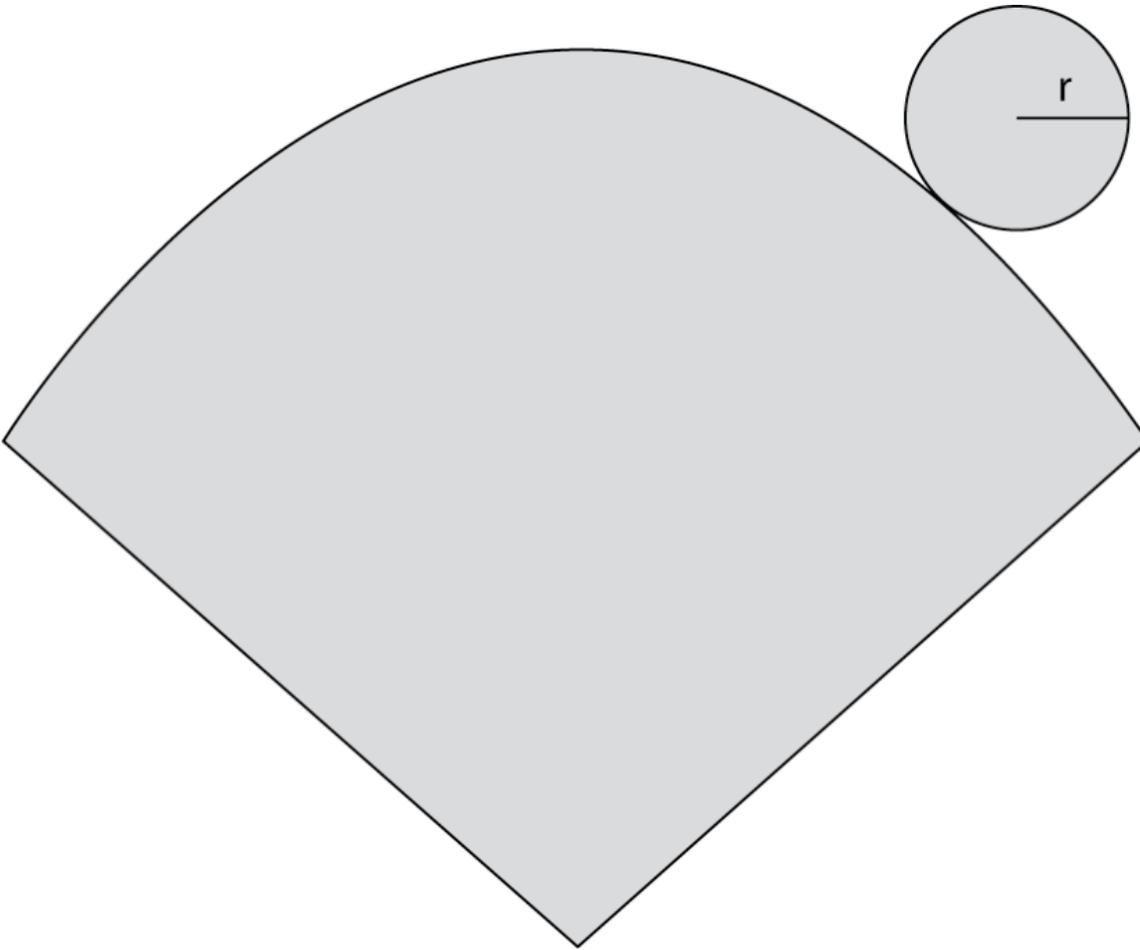
Cube



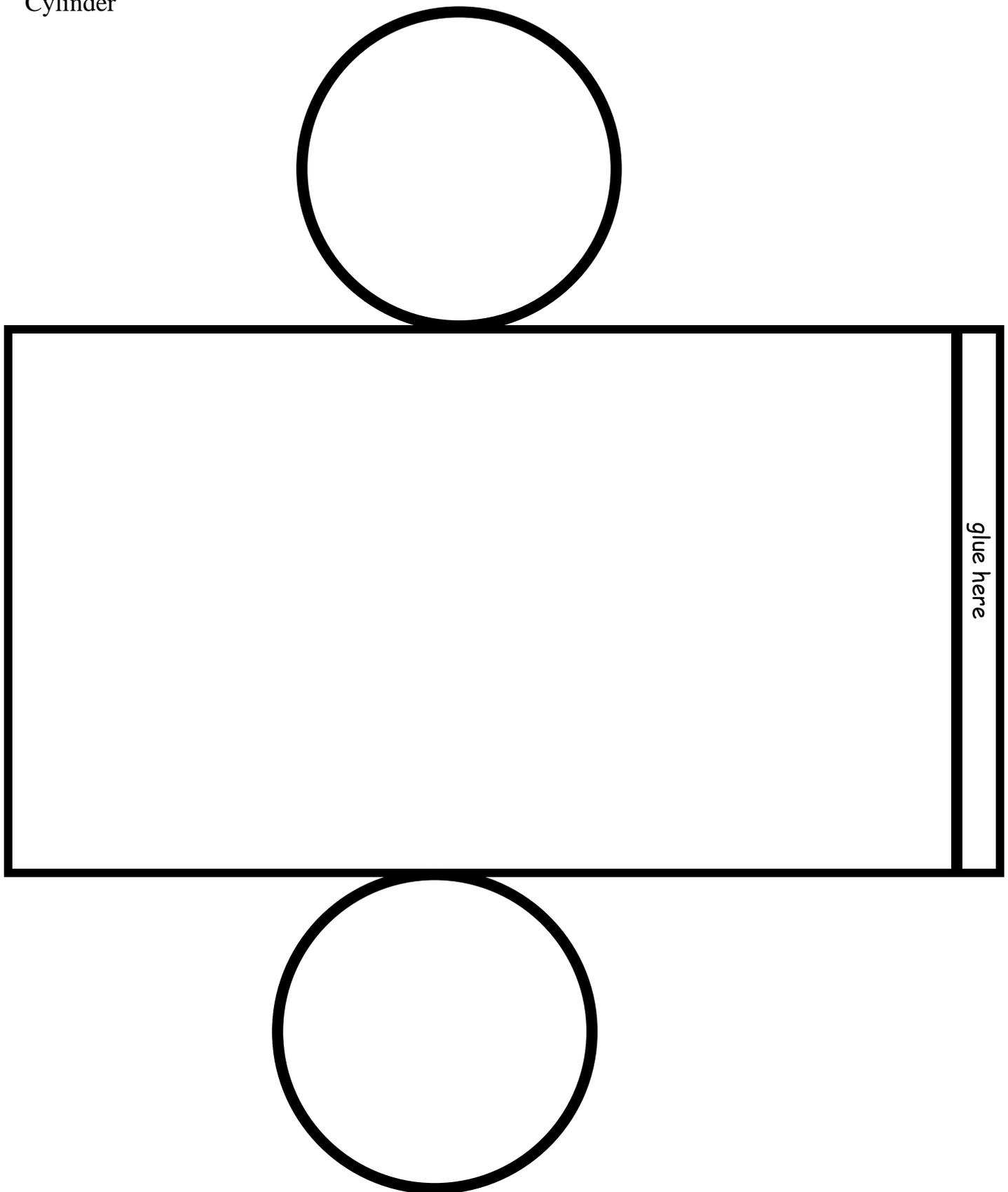
Rectangular Prism



Cone



Cylinder





Junior Architects: Designing My Geostructure

Today you will work as a junior architect to design a blueprint of a geostructure. First think about the different kinds of buildings that are found in a city. Then decide on the type of structure you will build.

Next, think about how your structure will benefit your community and what purpose it will serve.

Finally, decide on how your blueprint/geometric net will look. Write a description below. Use the math word wall to help you write your description.



Blueprint of My Geostructure Criteria

Name: _____ Date: _____
 Grade: _____ Teacher: _____

	1	2	3	4
Explanation	Missing key ideas.	Explanation is unclear.	Response shows a good understanding of geometric planes and solids in the real world.	Response shows complete understanding of geometric planes and solids in the real world.
Visual	No clear sketch.	Unclear sketch of net.	Clear sketch of net with most shapes and faces	Clear sketch of geometric net with appropriate shape and amount of faces
Demonstration of Knowledge	Drawing shows a complete lack of understanding of blueprints.	Drawing shows some understanding of designing a blueprint and has few details.	Drawing shows substantial understanding of designing a blueprint and has some details.	Drawing shows complete understanding of designing a blueprint and includes details.
TOTAL				

TOTAL: _____

Teacher Comments

Geocity Group Presentation Scoring Tool

Name: _____

Date: _____

Grade: _____

Teacher: _____

	1	2	3	4
Organization	Audience cannot understand presentation because there is no sequence of information.	Audience has difficulty following presentation because student jumps around.	Students present information in logical sequence.	Students present information in logical, interesting sequence.
Group Work	No evidence of working with other group members or sharing responsibilities.	Evidence of working together but some difficulty sharing responsibilities.	Evidence of working well with other team mates. Everyone takes part and shares responsibilities.	Team works very well together. Everyone assumes a clear role in decision making and responsibilities.
Visual Aids	Students use no visuals.	Students occasionally referred to visual aids that rarely supported the presentation.	Visual aids relate to presentation.	Visual aids explain and reinforce presentation.
Delivery/Verbal Techniques	Students mumble, incorrectly identifies math terms and speaks too quietly for audience to hear.	Students' voices are low, and they incorrectly identifies some math terms.	Students' voices are clear and they identify most math terms correctly.	Students use clear voices, and correct, precise identification of math terms.
TOTAL				

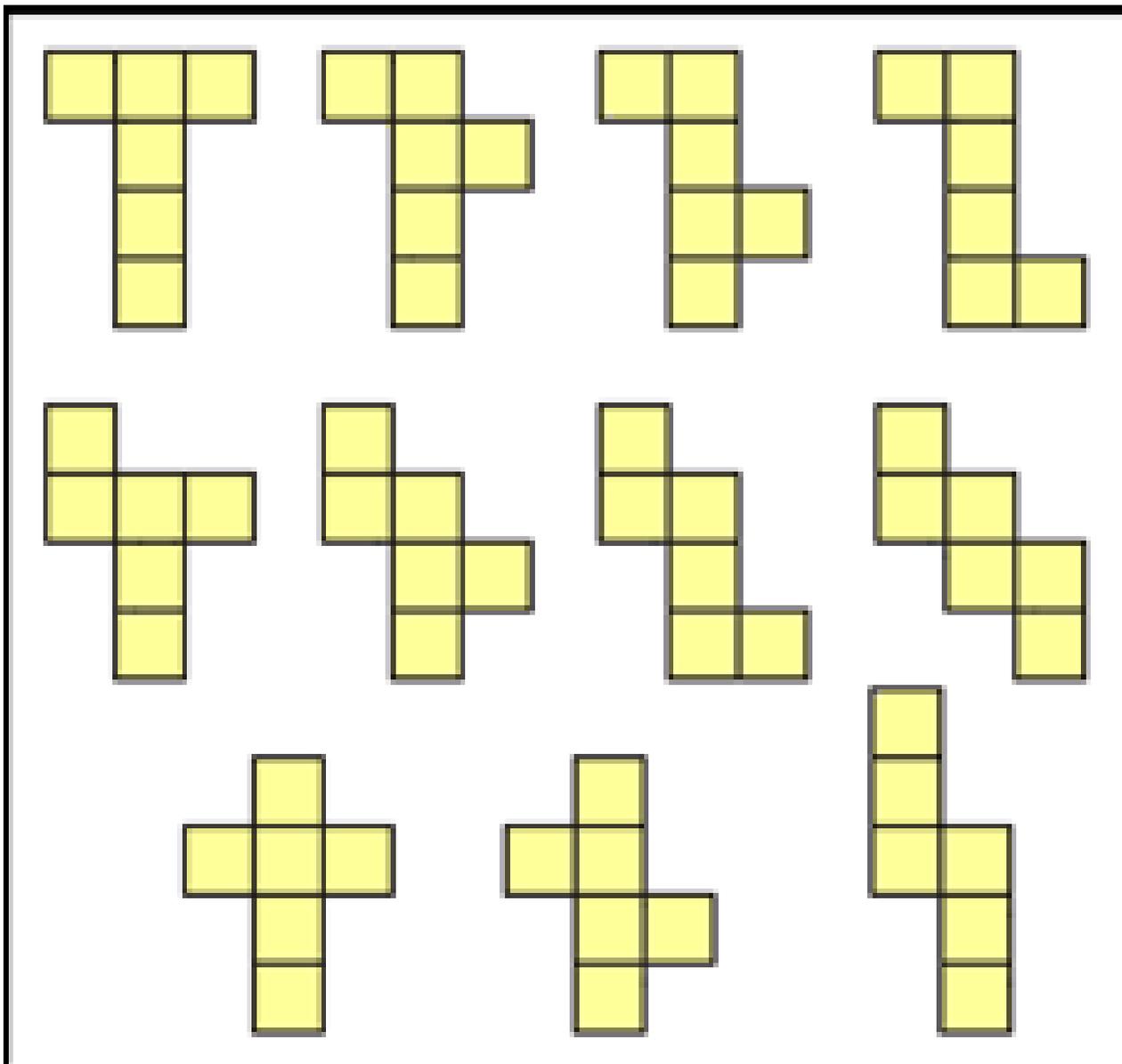
TOTAL: _____

Teacher Comments

Guess My Rule

<p>I'm a solid. I have six (6) faces that are all shaped like a square. Who Am I?</p>	Cube
<p>I'm a plane figure. I have 3 sides and 3 angles. Who Am I?</p>	Triangle
<p>I have 5 sides and 5 angles. I am named like a famous building in Virginia. Who Am I?</p>	Pentagon
<p>I am a 3-dimensional figure. I have 5 sides. 4 of my faces are triangular. The other face is a square. Who Am I?</p>	Pyramid
<p>I am a solid figure shaped like a shoe box. All of my 6 faces are rectangular. Who Am I?</p>	Rectangular Prism
<p>I am a 3-dimensional shape. I have no faces. If you put me on a table, I may roll around. Who Am I?</p>	Sphere
<p>I am a plane figure. I have six sides and six angles. Who Am I?</p>	Hexagon
<p>I am a plane figure, a regular polygon. I have 4 sides. All of my sides are equal. Who Am I?</p>	Square
<p>I have 3 dimensions. One of my faces is circular. You can fill me with ice cream! Who Am I?</p>	Cone
<p>I roll. Two of my faces are circles. Who Am I?</p>	Cylinder

There are only 11 nets that will form cubes. The following are configurations of nets that when constructed will form cubes.



Geometric Body Suits

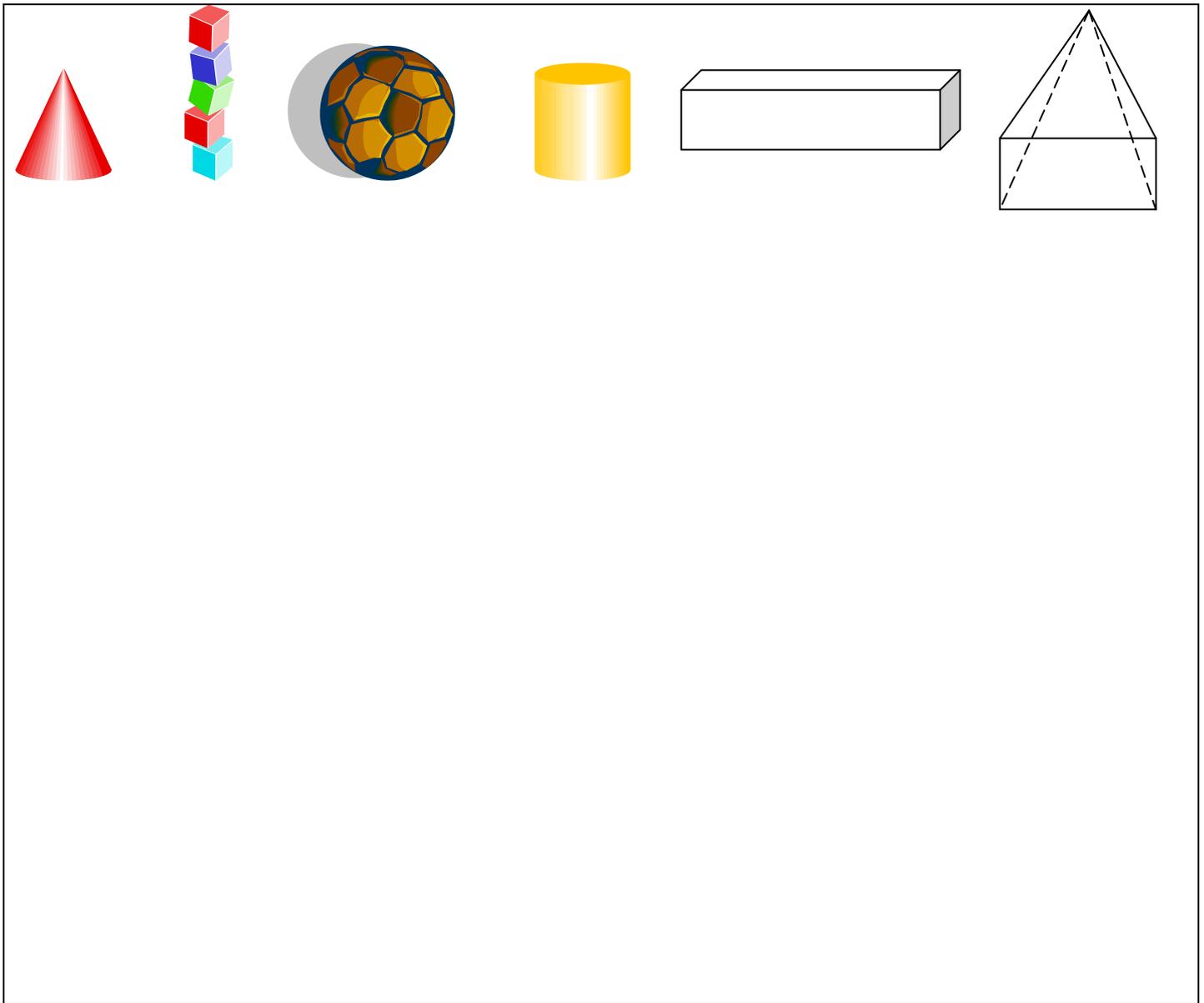
Net	Picture of the Solid	Name of the Solid
		Cube
		Rectangular Prism
		Pyramid
		Cylinder
		Cone

Name: _____ Date: _____

Geocity Summative Assessment

Directions: *Part 1*

Choose any two (2) of the geometric solids. Use the space provided to compare and contrast the figures. Give **at least** 2 differences for each figure and 2 similarities (4 points total).

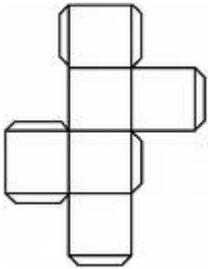


Name: _____ Date: _____

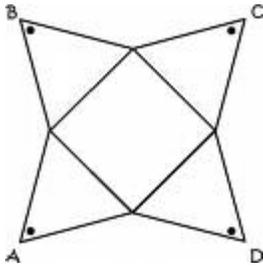
Geocity Summative Assessment

Directions: *Part 2*

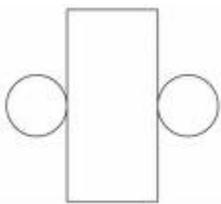
Match the net with the corresponding 3-dimensional shape. **Write an explanation** justifying your choice. (6 points total)



Cylinder



Cube



Pyramid
