



Grade Four Geometry



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February, 2011

Summary of Big Idea: Geometric Properties/Relationships

Van Hiele's Levels of Geometric reasoning acts as the foundation behind the activities and expectations which support the Big Idea within this handout. According to Mistretta (2000) geometry is an important part of the mathematics curriculum; unfortunately students are not demonstrating strong conceptual knowledge of this subject. The importance of creating learning activities which positively apply to students learning development in geometry is great, which is one of the main reasons we are focussing on it within this assignment.

The work of two Dutch educators, Pierre van Hiele and Dina van Hiele-Geldof, has given a vision around which to design the geometry curriculum. Through their research they have identified five levels of understanding spatial concepts through which children move sequentially on their way to geometric thinking. For the needs of meeting our grade 4 curriculum we have focussed on the first two levels described as Level 0- Visualisation and Level 2- Analysis. According to Halat (2008) research found mostly level-0 (Visualization) reasoning in grades K–8, and interviews with grade 6 students showed that individuals didn't surpass level I (Analysis). Based on these findings we have focussed our Big Idea around these two levels creating activities which will apply to the learning and completion of these levels.

The Visualisation Level involves students' visual perception being present where a figure/shape is seen as a total entity and as a particular shape. Here, properties are not considered in the identification of the shape/figure (Mistretta, 2000). Furthermore, at level 0 students think about shapes/figures in terms of what they resemble and are able to sort shapes into groups that "seem to be alike." For example, a student at this level might describe a rectangle as a "building." This supports our focus for the mathematical art activity described later within this handout where students are connecting real life objects to geometric shapes/figures. The Analysis Level involves students' ability to begin to identify properties of shapes/figures and learn to use appropriate vocabulary related to properties (Halat, 2008). This is the premise of the "What Am I?" activity described later within this handout where students must identify shapes and figures based on their property descriptions. According to Mistretta (2000) the two educators' research focuses on these levels in geometry and the role of the instruction in raising levels of thinking. It is the job of teachers and the experiences they provide which can allow

students to prosper through the levels which we hope would be provided through the hands-on activities which will be discussed shortly.

According to the website *Improving Measurement and Geometry in Elementary Schools-IMAGES* (2004) geometric experiences allow for the greatest success in moving throughout the levels which is why we have created hands-on experiences within our activities which are essential in students' ability to grasp the ideas within this big idea of geometric properties/relationships. It is important to provide hands-on learning experiences in order for the students to identify shapes within the curriculum and real life situations. According to *IMAGES* (2004) geometry taught in elementary schools should be informal. Where activities should be exploratory and hands-on, in order to provide students with the opportunity to investigate, build and take apart, create and make drawings, and to make observations about shapes. The *Ontario Mathematics Curriculum* (2005) supports this concept stating "to learn mathematics in a way that will serve them well throughout their lives, students need classroom experiences that help them develop mathematical understanding" (4). Students need to live out mathematical ideas in order to have an in-depth understanding; therefore we have focussed on moving as far away from handouts and desk work as possible by moving towards actual mathematical experiences that the students can take away with them each day. The *Ontario Mathematics Curriculum* goes on to state that "through mathematical activities that are practical and relevant to their lives, students develop mathematical understanding, problem-solving skills, and related technological skills that they can apply in their daily lives and, eventually, in the workplace" (4). This was taken into account while planning the activities within this handout where we have students up and moving around, identifying shapes/figures through oral communication, and identifying and recognizing shapes/figures within the real world.

In order for students to move on within the 5 levels of geometric reasoning they must pass through prior levels to than arrive at any specific level. It is important that students have a clear understanding during the first levels in order to ever fully grasp the rest of the levels; therefore making the first levels which are being focussed on a very critical point within the geometry curriculum. Teachers should not move on to the next level unless students understand the first, otherwise their growth may be stunted and they may never fully reach any of the other

stages. We focus two of our activities on the first level, and hope to reach the last three activities which focus on the second level; providing students develop the visualisation concept first.

Geometry is a vital part of the mathematic curriculum and improving students' conceptual understanding is critical which is why we have researched and developed the following experiential activities.

Activity One:**Title: Geometric Jeopardy****Strand: Geometry****Grade Level: 4****Overall Expectations:**

By the end of Grade 4, students will:

- identify quadrilaterals and three-dimensional figures and classify them by their geometric properties, and compare various angles to benchmarks;

Van Hiele's Level 0- Visualisation- Teacher will focus on this level until students are competent enough to move onto the next level. Here students identify the shape/figure as a whole rather than recognizing individual properties such as number of sides, faces, vertices, edges, etc.

Specific Expectations:

Identify and compare different types of quadrilaterals (i.e., rectangle, square, trapezoid, parallelogram, rhombus) and sort and classify them by their geometric properties (e.g., sides of equal length; parallel sides; symmetry; number of right angles);

Description of Activity:

Students will work in teams to participate in Geometric Jeopardy which will be set up on the smart board. Headings will focus on geometric properties where titles/categories will include, Triangles, Figures, Quadrilaterals, and Angles. The game will be played exactly like regular Jeopardy (except that there will only be questions up to 400).

Example of Geometric Jeopardy Board

Jeopardy				
Angles	Line/Line Segments/ Rays	Triangles	Quadrilaterals	Polygons
100	100	100	100	100
200	200	200	200	200
300	300	300	300	300
400	400	400	400	400

Teams will take turns choosing a category and points where they will work as a team to answer the question. An example of choosing the category **Figures** would be: Name this figure, with a picture of a cone. Here in the visualisation level the game would not go into details of properties or relationships; focussing just on figures and shapes from a holistic viewpoint for students.

Questions within the game which are worth more points will require the use of manipulatives and problem solving.

This activity will allow students to work cooperatively together while reviewing the concepts they have been learning within their Geometry Unit.

Accommodations and Modifications

ESL students will work with a higher levelled partner; working together to identify the shape/figure being described.

May have to include differentiated learning based on which level each of your students are at within Van Hiele's Level of geometric reasoning. Some scaffolding may need to occur if some students are not even at level 0.

Scaffolding ideas could include grouping those individuals below level 0 with individuals who are at level 0 as a means of working together to answer the questions.

Questions could also be varied where some questions would be very general and some specific; meeting the needs of each learner.

Consolidation

Students will share one piece of information they learned from the Jeopardy Game, in their table groups.

Assessment Strategies

This will act as a formative assessment for the teacher to get a feel for the student's competency levels when it comes to geometric knowledge.

Teacher will observe who is participating during the activity and make note of who is struggling to work cooperatively with the group to answer questions.

Students will be assessed during sharing aspect of the activity in which the teacher will make note of who is participating, sharing, and using correct description words and geometric property identification.

Teachers Resources and Hints

Scaffold questions when designing the jeopardy game and make sure to include questions which require experiential learning as this is the most successful activity to provide for students learning geometry.

Activity Two: Geometry Art**Strand: Geometry****Grade Level: 4****Specific Expectations:**

Math - identify and compare different types of quadrilaterals (i.e., rectangle, square, trapezoid, parallelogram, rhombus) and sort and classify them by their geometric properties (e.g., sides of equal length; parallel sides; symmetry; number of right angles);

Create and analyse symmetrical designs by reflecting a shape, or shapes, using a variety of tools (e.g., pattern blocks, Mira, geoboard, drawings), and identify the congruent shapes in the designs.

Visual Art - D1.3 use elements of design in art works to communicate ideas, messages, and understandings

Level 0 Visualisation- Students identify shape and figure as a whole but are unable to identify specific properties.

Description of Activity:

The image below was uploaded from <http://www.la-art-tutor.com/2007/10/17/one-point-perspective-drawing/> this image will be used to outline for students, the requirements and instructions for this “Geometry Art” activity

1. Teacher will facilitate a 3 – 5 minute teacher led discussion.
2. Teacher will pull up the image below on the smart Board or provide students with a hardcopy.
3. As a class, students will be asked to brain storm the geometric shapes and figures that they see in this perceptive art
4. Next the teacher pulls up each geomantic shape the students are learning about on the Smart board or black board. The shapes should be clearly drawn and labelled.
5. Teacher instructs students to draw a picture of anything that they would like using 5 – 7 geometric shapes and figures. The students must use at least four different geometric shapes and figures in their drawing. Allow students to cut out three dimensional figures and paste them in their drawing if they are not comfortable drawing them. Instruct students to “camouflage” the shapes and figures by making them into something that we see in our everyday life. EX a rectangular prism can be “camouflaged: as a building.
6. Teachers give students the handout below. This handout will be used as a checklist for students to keep track of the shapes and figures they have drawn inside their picture. The upper part of the hand out is a checklist for the student’s personal drawing. The lower

part of the handout will be used to detect the geometric shapes found in their partners art work. Instruct students no to let their partner see the upper part of their handout.



Accommodations and Modifications

Students may feel apprehensive about creating the geometry art if they are not strong in visual arts. Allow students to trace two dimensional geometric shapes rather than drawing them free hand. Allow students to cut out three dimensional figures and “camouflage” them in their picture. Allow students to use math manipulatives if they wish during this discussion.

Scaffolding may have to take place based on the level of each student within The Van Hiele Level of Geometric Reasoning. For example, students at a lower level may use teacher’s assistance to choose shapes for their artwork and then identify the hidden shapes with a partner.

Consolidation:

Students will brain storm as a class, the commonalities between the geometric shapes and figures outlined in the geometric art activity.

On the Black board o Smart board teacher writes the following questions:

1. **How did you recognize the shape or figure?**
2. **How did you know it was a square?**
3. **How did you know this was a cube?**

Assessment Strategies

Geometry art requires formative assessment. Teacher will walk around the classroom during this lesson and mentally assess the student's competency with geometry and provide students individual feedback aiding them to improve their skills. Teachers should jot down notes about the individual needs of each student to get a sense of the class's geometry competency. The Teacher should continue to use the rubric from the word wall activity.

Names:	Can differentiate between shapes and figures	Can identify properties of shapes	Works co Cooperatively with peers	Exhibits evidence of critical thinking	NOTES:
Alice	X Feb 6th			X Feb 6th	<i>Feb 6th Level 0 on van Hiels module/ difficulties explaining her reasoning to teachers and peers.</i>
Joan	X Feb 6th		X Feb 10th		<i>Feb 10th Works better with peers once geometry competency improved.</i>
Marko		X Feb 6th	X Feb 6th		
Jahnyl		X Feb 10th	X Feb 6th		

Teachers Resources and Hints

In order to teach the specific expectation, teachers must engage students in the consolidation discussion. Encourage manipulative usage in all students. Research has shown that “geometry and algebra phobia” takes place in many high school students. Do your best to make geometry fun, engaging integrative and understandable for all students!

Name: _____

Inside my artwork I have hidden:

A total of _____ Shapes A total of _____ Figures

The Shapes that I have hidden are:

Name	Quantity	Shape or Figure?
Rectangle	2	shape
Cube	1	figure

I detected that inside my friend _____ art there are:

Name	Quantity	Shape or Figure?
Rectangle	2	shape
Cube	1	figure

Activity Three: Geometry Word Wall**Strand: Geometry****Grade Level: 4****Overall Expectations:**

By the end of Grade 4, students will:

- identify quadrilaterals and three-dimensional figures and classify them by their geometric properties, and compare various angles to benchmarks;
- construct three-dimensional figures, using two-dimensional shapes;
- identify and describe the location of an object, using a grid map, and reflect two-dimensional shapes.

Van Hiele's Level 1- Students are able to identify shapes and figures as a whole, as well as identify and relate specific properties.

Specific Expectations:

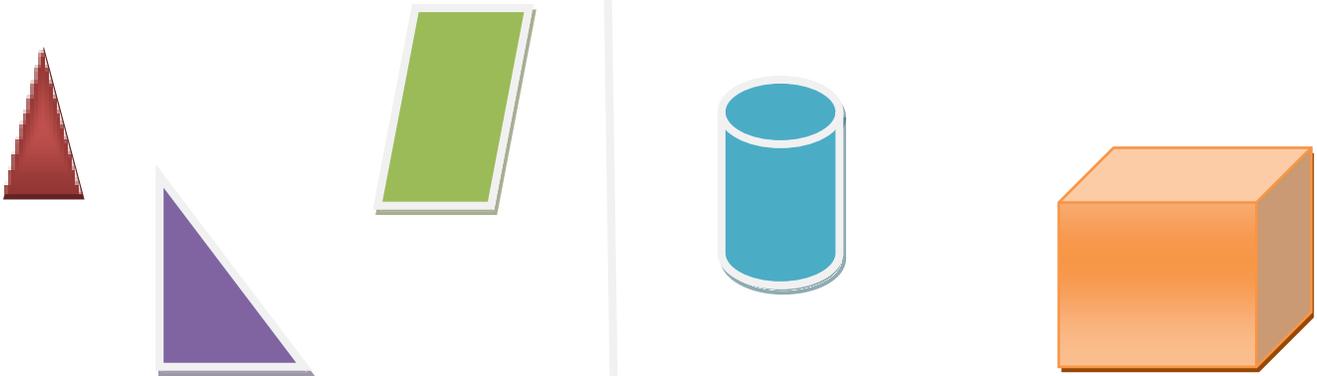
Math - draw the lines of symmetry of two dimensional shapes, through investigation using a variety of tools (e.g., Mira, grid paper) and strategies (e.g., paper folding)

– identify and compare different types of quadrilaterals (i.e., rectangle, square, trapezoid, parallelogram, rhombus) and sort and classify them by their geometric properties (e.g., sides of equal length; parallel sides; symmetry; number of right angles);

– identify and describe prisms and pyramids, and classify them by their geometric properties (i.e., shape of faces, number of edges, number of vertices), using concrete materials.

Description of Activity:

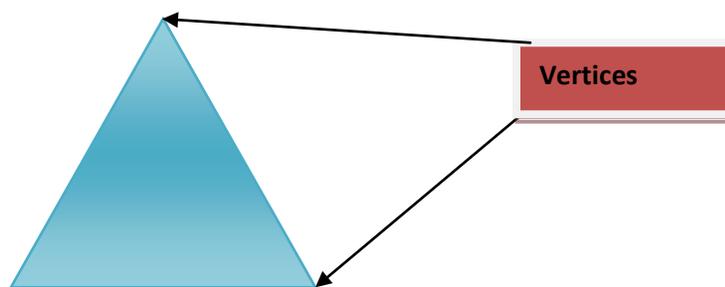
Students will create a geometry word wall. The word wall will contain both two dimensional shapes and three dimensional figures. The display of the word wall is outlined in the image below.

Two Dimensional Shapes**Three Dimensional Figures**

This diagram does not represent all shapes and the figures on the word wall.

Each Table group will be responsible for creating certain two dimensional shapes and three dimensional figures. The Three dimensional figures will protrude from the wall. (Note use a hot glue gun to glue the three dimensional figures to the wall.

The word wall employs differentiated learning as students will be at various levels of geometric competency. Students will create geometric shapes through using Mira grid paper and folding strategies. Students will create arrows that will point to vertices edges and right angles. The arrows will be mobile, making the word wall an interactive learning tool. An example is outlined below:



Accommodations and Modifications

ESL students will work with a higher levelled partner; working together to identify the shape/figure being created.

May have to include differentiated learning based on which level each of your students are at within Van Hiele's Level of geometric reasoning. For example Students who are at Level 0 (Visualization Stage) will be responsible for drawing/tracing two dimensional figures. Students in Level 1 (Analysis Level) will be responsible for labelling the properties of figures and shapes. Students in Level 0 and Level 1 will work in table groups so peer learning can occur.

Consolidation

Teacher will have a brief teacher lead discussion about the two dimensional and three dimensional figures that are on the word wall. Teacher will describe situations where the word wall will be useful for students. Teacher will invite students to suggest new additions to the word wall if they discover a shape or figure that is not represented on the word wall.

Assessment Strategies

Teacher will keep a tracking sheet and do formative assessments on students during the activity teachers should ask questions such as

1. How many equal sides does a polygon have? How do you know that?
2. Does that shape (point to shape) have a right angle? How do you know that?
3. What is the difference between shapes and figures? Can you give me an example of a Shape and an example of a figure?

During the word wall activity the teacher should employ formative assessment as a means to assess the student's geometry level of competency.

A sample formative assessment rubric is presented on the following page:

Names:	Can differentiate between shapes and figures	Can identify properties of shapes	Works Cooperatively with peers	Exhibits evidence of critical thinking	NOTES:
Alice	X Feb 6th	X Feb 6th		X Feb 6th	<i>Level two on van Hiels module/ difficulties explaining her reasoning to teachers and peers.</i>
Joan	X Feb 6th				
Marko		X Feb 6th	X Feb 6th		
Jahnyl			X Feb 6th		

Teachers Resources and Hints

Teachers should read this document to aid them in creating geometry word walls.

<http://datadeb.files.wordpress.com/2009/11/001-word-wall-post-for-blog.pdf>

Activity Four:**Title: Mystery Flash light****Strand: Geometry****Grade Level: 4****Overall Expectations:**

By the end of Grade 4, students will:

- identify quadrilaterals and three-dimensional figures and classify them by their geometric properties, and compare various angles to benchmarks;
- construct three-dimensional figures, using two-dimensional shapes;
- identify and describe the location of an object, using a grid map, and reflect two-dimensional shapes.

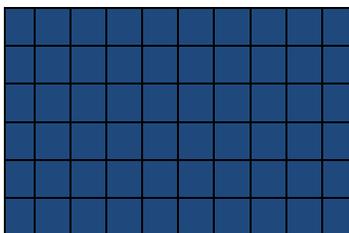
Van Hiele's Level 1- Analysis- Students are able to describe and identify different properties within shapes and figures.

Specific Expectations:

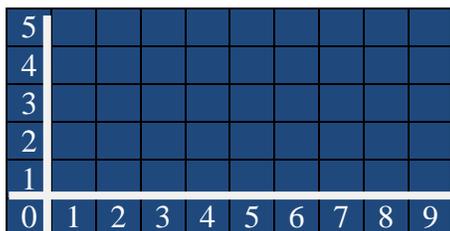
Identify and compare different types of quadrilaterals (i.e., rectangle, square, trapezoid, parallelogram and rhombus) and sort and classify them by their geometric properties (e.g., sides of equal length; parallel sides; symmetry; number of right angles);

Description of Activity:

Each partner pair, will have two 13X11 pieces of black paper with grid lines taped to the wall. (Teachers create the grid lines, corresponding to their desired size.



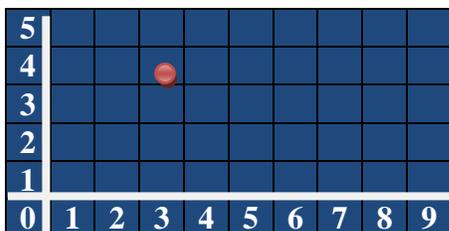
Teacher must label the black grid paper as it is a bar graph. See next page.



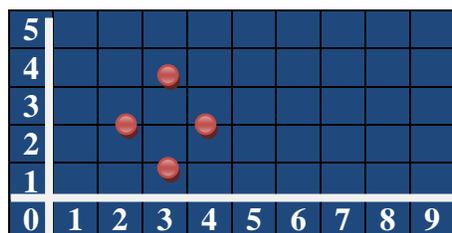
In partners, students are given a cue card with specific coordinates. For example,

Coordinate 1 = X4, Y3

One student must flash a small laser at coordinates 1, and then mark it on the black grip paper with chalk.



Students will continue this method for each of the coordinates on the cue card.

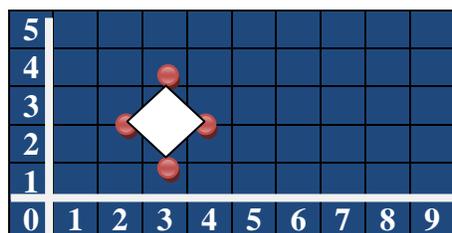


Coordinate 2 = X1, Y3

Coordinate 3 = X2, Y2

Coordinate 4 = X2, Y4

Once the students have marked their coordinates they must think critically about what geometric shape they could create using the coordinates that they have marked.



With a ruler students will connect the coordinates to reveal a two-dimensional geometrical shape.

Each set of partners in the class are responsible for making at least two geometrical shapes. Once the class is finished all students will do a gallery walk and “critique” the geometrical shapes with the “Mystery Flashlight detective Sheet.

Accommodations and Modifications

Write all the geometric shapes that are a part of the Mystery Flashlight lesson on the Smartboard or blackboard for spelling purposes.

Have geometric shape manipulatives available for students use. Students can decipher which geometric shape they have created by placing the manipulative inside the co ordinates plotted on the paper grid.

Individuals who have not yet reached level 1 Analysis stage will be responsible for deciphering the overall shape, while those higher level students will work on the specifics, properties, etc.

Consolidation

After the gallery walk students can cut out the two dimensional shapes that they have created. Students must classify their shapes according to the number of vertices the shape contains in bins.

Assessment Strategies

Teacher will continue to use the formative assessment rubric, to asses’ student geometry competency and support them in further learning.

Teachers will complete a summative assessment of the final mystery flashlight decoding sheet and apply a grade.

Teachers Resources and Hints

Teachers should plot the vertices of geomantic math manipulatives. Print Geometric shapes online at <http://www.freeprintable.com/view/print.html?id=841>

Simply place the geometric shape print outs on the 13X10 black grid paper and lightly mark each vertex. Then write out the vertices coordinates on the cue cards that your students will use for the Mystery flashlight activity.

Detective: _____

MYSTERY FLASHLIGHT DECODING SHEET

Shape Decoded	Number of Vertices	Where Can I find this shape?
Square	4	Tiles Pizza Box

Activity Five:**Title: What Am I?****Strand: Geometry****Grade Level: 4****Overall Expectations:**

By the end of Grade 4, students will:

- identify quadrilaterals and three-dimensional figures and classify them by their geometric properties, and compare various angles to benchmarks;

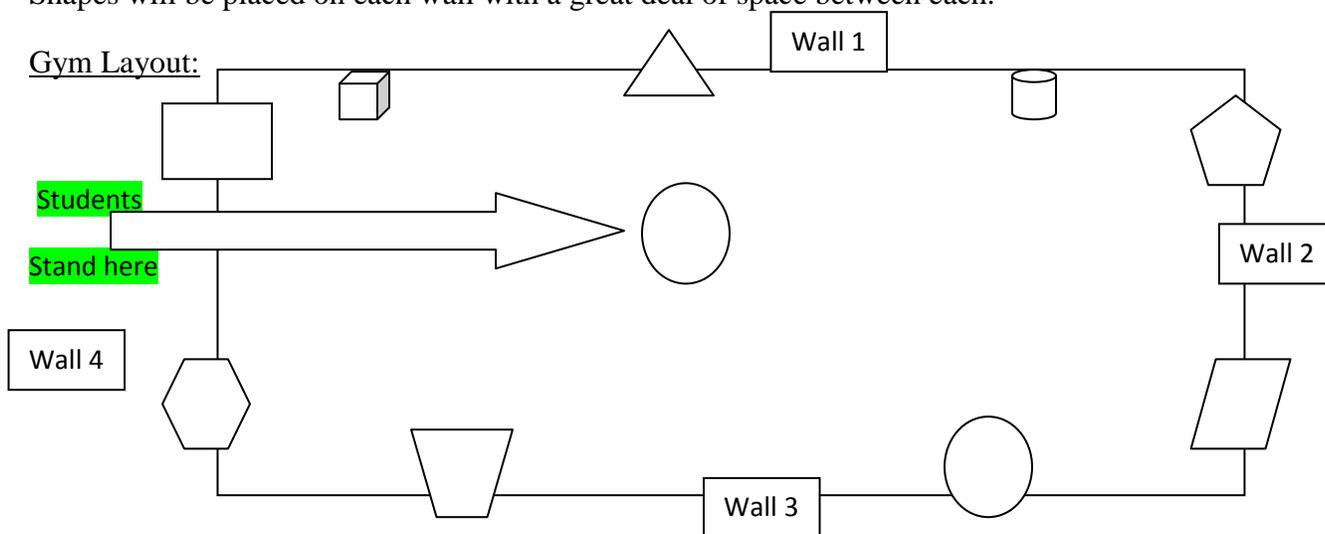
Van Hieles' Level 1: Analysis – Teacher will evaluate whether students are ready to move onto this activity based on whether or not they exhibited competency within Level 0- visualisation stage. This is extremely important as moving on before students are ready could stunt their growth within the levels.

Specific Expectations:

Identify and compare different types of quadrilaterals (i.e., rectangle, square, trapezoid, parallelogram, rhombus) and sort and classify them by their geometric properties (e.g., sides of equal length; parallel sides; symmetry; number of right angles);

Description of Activity:

This activity will take place within the school gym to meet safety precautions and use of space. A math game will be set up using the shapes the students created in the mystery flash light activity/word wall where different shapes/figures will be hung on the four walls of the gym. Shapes will be placed on each wall with a great deal of space between each.



Students will stand in the middle of the gym while one student volunteer reads the “What am I?” card. Each card includes geometric property descriptions for example **Card 1: I am a shape, I have 4 parallel sides, and 4 vertices, what am I? Answer: Square**

Students will take turns volunteering to be the card reader while the other students in the middle of the gym must run to the shape/figure located on the wall which they believe is being described. The card will be read and students must wait till they hear the whistle before they move to the shape.

Each time students will be instructed to go to the shape/figure through different movements; examples include crab walk, duck walk, cat walk, frog jumps, speed walk, hop, etc.

While at the shape/figure the students choose they must discuss with a partner why they believe it to be the shape/figure described by pointing out the properties and explaining their thought processes.

This activity will allow students to practise matching property descriptions to actual geometric shapes. The hands on approach will be motivating for the students and they will be excited and eager to identify each geometric shape/figure; while being physically active.

Accommodations and Modifications

Students with physical disabilities are able to write the shape down they believe is being described (rather than moving to the shape/figure on each wall).

ESL students will work with a higher levelled partner; working together to identify the shape/figure being described.

Teacher may have to include differentiated learning based on which level each of their students’ are at within Van Hiele’s Level of geometric reasoning. Some scaffolding may need to occur if some students are at level 0 and some are at level 1.

Consolidation

Teacher will lead a community circle where students will share their strategies during the game and how they were able to identify the different shapes/figures.

Assessment Strategies

Teacher will observe who is participating during the “What Am I?” game and make note of who is struggling to identify each shape/figure.

Students will be assessed during the community circle in which the teacher will make note of who is participating, sharing, and using correct description words and geometric property identification.

Teachers Resources and Hints

**Try to move students away from descriptive vocabulary such as corners, and encourage them to use the word vertices. You want to encourage proper use of vocabulary and look for proper ways of describing geometric properties.

“What Am I” Cards

Examples:

Card 1: I am a shape that has 4 parallel sides, and 4 vertices, what am I? **Answer: Square**

Card 2: I am a shape that has 3 vertices, 3 sides, and 3 angles, what am I? **Answer Triangle**

Card 3: I am a shape that has 4 sides, 4 vertices, and 2 sets of parallel lines, what am I? **Answer: Rectangle**

Card 4: I am a shape that has 6 sides, and 6 vertices, what am I? **Answer: Hexagon**

Card 5: I am a shape that has no corners and one continuous side, what am I? **Answer: Circle**

Card 6: I am shape that has 4 vertices and 2 sets of parallel lines, what am I? **Answer: Parallelogram**

Card 7: I am a figure that has 6 faces, 8 vertices, and 12 edges, what am I? **Answer: Cube**

Card 8: I am a figure that has 5 faces, 6 vertices, and 9 edges, what am I? **Answer: Triangular Prism**

Card 9: I am a figure that has 3 faces, and 2 edges, what am I? **Answer: Cylinder**

Reference Guide

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