INFORMATION FOR TEACHERS

The math behind DragonBox Elements

- explore the elements of geometry -

Includes exercises and topics for discussion

WE WANT TO KNOW

General information

DragonBox Elements

Teaches geometry through play and exploration

DragonBox Elements is a game which was designed to teach the big ideas of Euclidian geometry through play and exploration. It is also an excellent way to help students enjoy doing proofs and play with geometric concepts from their curriculum.

The best way to use the game is to discover and discuss the game with the students and embark on a learning journey that will challenge how they experience geometry.

In this document, we provide some general information about DragonBox Elements, more about the math behind the game, and suggestions for exercises and useful topics for discussion.

It is important that after each new rule or chapter, the students describe what they have experienced in the game in their own words and discuss with each other. By relating the discussion to the curriculum, we create a link between the game and the math behind which gives a great learning effect.

Content of the game

DragonBox Elements includes more than 110 different levels where you can explore the properties, definitions and relations of geometric shapes through Euclidian proof. Shapes and concepts covered include: line segments, triangles (scalene, isosceles, equilateral, right-angled), circles, quadrilaterals (rhombus, trapezoid, parallelogram, rectangle, square), special pairs of angles, and parallel and transversal lines.

Chapters

The levels are organized in 7 different chapters. In each chapter, you learn new rules, or "powers". The levels which include new powers are marked with a crown above the level number in the tower interface. See table 1 for an overview of the rules in the game and what they represent.

This information could be used as a starting point for discussion at school while the game is played.

Figures and controls

The player will meet different figures in the game, each of which symbolize a shape or a property. To select a shape or figure in the game, you tap it.

See table 2 for an overview of the figures and how to create them in the game.

Table 3 gives an overview of the controls for different shapes and angles.

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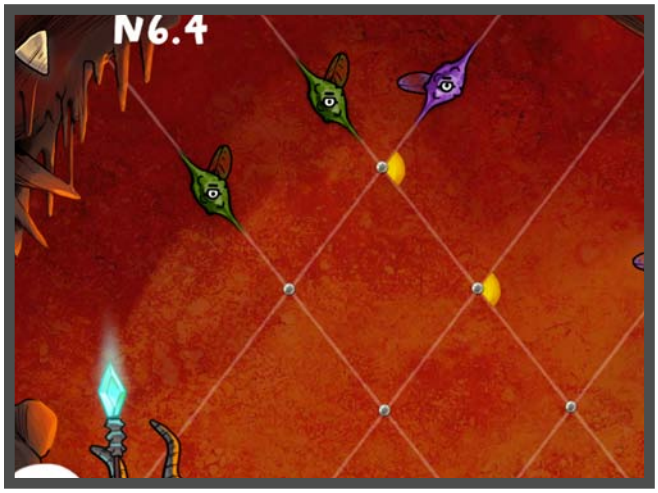
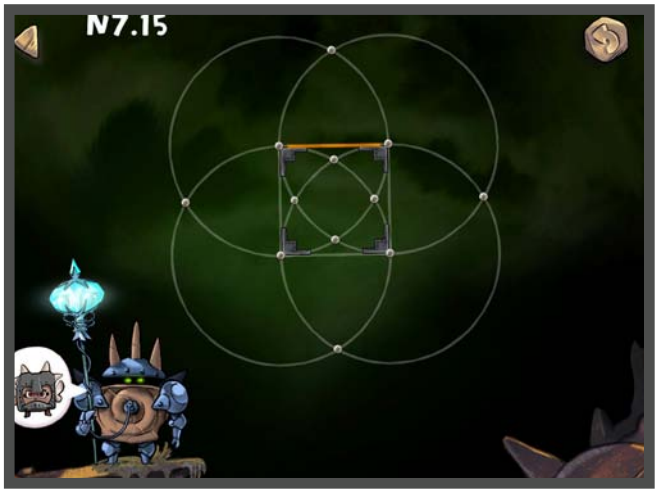
Examples

Game levels





Overview

Rules

Chapter/Level	About the new rule/"power"
	**Definition of a triangle, level 1.1** Shapes consisting of **line segments** (lines with two endpoints) are called **polygons**. The **triangle** is the simplest form of a polygon. Triangles are made up of three line segments, or sides, and three vertices where the sides meet. The interior angles of a triangle total 180°.
	**Definition of a quadrilateral, level 1.5** A **quadrilateral** is a polygon with four line segments, or sides, and four vertices where the sides meet. The interior angles of a quadrilateral total 360°.
	**Definition of an isosceles triangle (sides), level 2.1** An **isosceles triangle** is a triangle with at least two congruent sides (two equal sides). Two objects are congruent if they are of the same size and shape.
	**Definition of an equilateral triangle (sides), level 2.5** An **equilateral triangle** is a triangle with three congruent sides (three equal sides).
	**Properties of a circle, level 2.9** Given any straight line segment, a circle can be drawn having the segment as **radius** and one endpoint as center. The radius of a circle will then be the length of a line segment from its center to its perimeter (**circumference**).

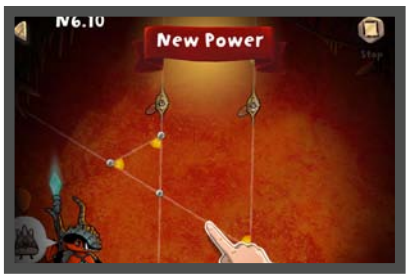
Overview Rules

Chapter/Level	About the new rule/"power"
	**Properties of isosceles triangles and what is given, level 2.16** The two congruent sides (same length) of an isosceles triangle are called **legs**. If it is given that a triangle is an isosceles triangle, then it follows that two legs of that triangle are congruent. In the game, the congruent legs meet at the common point indicated by the triangle's glowing tail. If you know the length of one of the congruent legs, then you can prove that the second leg is congruent by double-tapping the isosceles triangle icon.
 	**Triangles and angles, levels 3.1, 3.2** Angles consist of two rays with a common endpoint (rays are lines which have one endpoint and go on infinitely in the other direction). The common endpoint is the **vertex** of the angle. The size of an angle is measured according to the degree of rotation from one ray to the other, with the vertex as the center of rotation. The Isosceles Triangle Theorem states that if two sides of a triangle are congruent, then the angles opposite those sides are congruent. Conversely, if two angles of a triangle are congruent, then the sides opposite those angles are congruent. For the equilateral triangle, the triangle is equilateral if and only if it is equiangular, and each angle of an equilateral triangle is 60°.
	**Definition of opposite angles, level 3.6** Whenever two lines cross, we get two pairs of equal, opposite angles. These pairs are called **vertical** or **opposite angles**. These angles are always congruent according to the Vertical Angle Theorem.
	**Properties of equilateral triangles and what is given, level 3.14** If a triangle has three congruent sides, then it is given that the triangle is an equilateral triangle. If the triangle is equilateral, then it also follows that it is equiangular.

Overview Rules

Chapter/Level	About the new rule/"power"
	**The properties of a rhombus, level 4.1** Quadrilaterals (polygon with four line segments or sides) can be divided into different types, including a type with 4 equal sides called a **rhombus**. The rhombus has all the same properties as a parallelogram with two pairs of equal parallel opposite sides (the sides will not intersect or touch at any point in a plane). In addition, 1) all four sides of a rhombus are congruent, 2) the diagonals bisect pairs of opposite angles, and 3) the diagonals are perpendicular. The perpendicular diagonals are lines joining two non-consecutive points/ vertices of the polygon which meet at a right angle (90°).
	**Properties of the rhombus and what is given, level 4.10** If it is given that a quadrilateral is also a rhombus, and we know the length of one or more sides, we then know the length of the remaining sides since all four sides in a rhombus are congruent.
	**Properties of a trapezoid and parallel lines, level 5.2** A **trapezoid** is a quadrilateral with exactly one pair of parallel sides. The parallel sides are lines which will not intersect or touch at any point in a plane.
	**Properties of parallelograms, level 5.5** A quadrilateral with two pairs of equal parallel opposite sides is called a **parallelogram.**

Overview Rules

Chapter/Level	About the new rule/"power"
	**Parallel and transversal lines, level 5.10** If a **transversal line** intersects two parallel lines, then the pairs of corresponding angles are congruent (see image). Conversely, if a transversal intersects two lines and the corresponding angles are congruent, then the lines are parallel.
	**Parallel and transversal lines, and the transitive property of equality, level 6.1** If a line A is parallel to a line B and a line C is parallel to line B, then line A and line C must be parallel through **the transitive property of equality.**
	**Properties of a parallelogram and what is given, level 6.8** If it is given that a quadrilateral is also a parallelogram, then we know that it has two pairs of equal parallel opposite sides.
	**More on angles, parallel and transversal lines, level 6.10** If a transversal line intersects two parallel lines, then we know that the pairs of **corresponding angles** are congruent.
	**Properties of a rectangle, level 7.1** A **rectangle** is a quadrilateral with four right angles. A rectangle could also be called a parallelogram with four right angles. In addition to the properties of a parallelogram, the rectangle is defined by 1) all four angles are right angles (90°) and 2) the diagonals are congruent.

Overview

Rules

Chapter/Level	About the new rule/"power"
	Right-angles and supplementary angles, level 7.4 Adjacent angles are any two angles that share a common side and a common vertex and don't overlap. If the sum of two angles is 180°, then these angles are called **supplementary angles**. Any two adjacent angles that form a linear pair are supplementary angles. Therefore, if we know that one angle in the linear pair is 90°, then we also know that the other angle is of the same size since 90° + 90° = 180°.
	**Properties about right-angles triangles, level 7.10** A **right triangle/right-angled triangle** is a triangle with one internal angle equal to 90°.
	**Properties of a rectangles and what is given, 7.13** If it is given that a quadrilateral is a rectangle, then we know that it has four right angles (90°) and two pairs of parallel sides.
	**Properties of a square, level 7. 15** A **square** is a quadrilateral which is both equilateral (all four sides of the same size) and right-angled (all four angles of the same size, 90°)

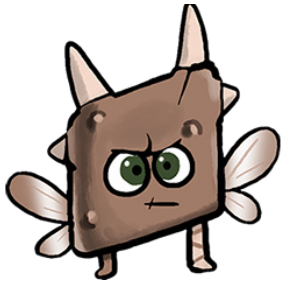
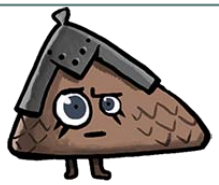
Overview

Figures

FIGURES	WHAT DO THEY SYMBOLIZE	HOW TO CREATE EACH FIGURE
 **Triangulum**	The simplest polygon that exists, a triangle whose sides are three different lengths. Triangulum is also known as a scalene triangle.	Trace the sides of a three-sided figure to create Triangulum.
 **Isosceles**	A triangle with at least two sides of the same length, an isosceles triangle. If the triangle has at least two sides of equal length, then they also have at least two equal sized angles (base angles).	You can identify an isosceles triangle in the game if a Triangulum has two equal length sides, identified by the same color, or two angles of the same color. Tap the equal sides or angles to evolve Triangulum into Isosceles. In some levels, if the figure is glowing, you can double-tap to add sides or angles.
 **Aequilaterus**	A triangle with three sides of equal length or three angles of the same size, an equilateral triangle. Each angle of an equilateral triangle is 60°.	You can identify an equilateral triangle in the game if a triangle has three sides of the same color or three angles of the same color. Tap the sides or angles to evolve Triangulum into Aequilaterus. If the figure is glowing, then you can double-tap to add sides or angles.
 **Quadrilaterum**	A quadrilateral, a polygon composed of four straight lines connected by four end points.	Trace the sides of a four-sided figure to create Quadrilaterum.
 **Trapezium**	A trapezoid is a quadrilateral with exactly one pair of parallel sides.	Trapezoids in the game have one pair of opposite parallel sides, which are marked by a pair of flying eyes figures. To create a trapezoid, tap the Quadrilaterum and then one pair of opposite flying eyes. Because this proves that Quadrilaterum has one pair of opposite parallel sides, it will evolve him into Trapezium. Double tap the Trapezium to make a pair of flying eyes appear.

Overview

Figures

FIGURES	WHAT DO THEY SYMBOLIZE	HOW TO CREATE EACH FIGURE
 **Rhombus**	A rhombus, which has all of the properties of a parallelogram. In addition, rhombuses have four equal sides and perpendicular diagonals that bisect opposite angles.	To identify a rhombus in the game, look for a quadrilateral with four sides of equal color, meaning the sides are of equal length. Tap the Quadrilaterum and then tap the four equal sides to create the figure Rhombus, symbolizing a rhombus. If the figure is glowing, then you can double-tap to add additional equal length sides.
 **Parallelogrammum**	A quadrilateral with two pairs of parallel and equal opposite sides is a parallelogram. Also, if both pairs of opposite angles of a quadrilateral are the same size, then the quadrilateral is a parallelogram.	To show that a quadrilateral is in fact a parallelogram, state that its opposite sides are parallel by tapping each opposite pair of flying eyes (which indicate that opposite lines are parallel). Double tap the Parallelogram to make two pairs of parallel lines (flying eyes) appear.
 **Trirectus**	Right-angled triangle with one angle equal 90°	Find a triangle that has one angle marked as a right angle (metal), then click on the angle to get Trirectus, a right-angled triangle.
 **Rectangulum**	A rectangle is a quadrilateral with four right angles. It has two sets of parallel sides	To identify a rectangle, find any quadrilateral which has four right angles, tap on Quadrilaterum and then on the four angles to evolve into Rectangulum.
 **Quadrum**	A square is that which is both equilateral (all sides are of same length) and right-angled (all angles 90°)	To show that the quadrilateral is a square, tap all four right-angles and all four sides of the same color to evolve Quadrilaterum into Quadrum.

Overview

Controls

Shapes/angles	Controls
Polygons (triangles, quadrilaterals)	Draw polygons by tracing the lines with your finger, connecting the endpoints
Circles and radius	Rotate the radius (line segment connecting center point to border of circle or circumference) of the selected circle to show that all radii in the circle have the same length (color).
Angles	Select the angle you want to move by tapping once. Two angles are of equal size if they have the same color.
Opposite angles	For opposite angles, swipe the selected angle to the angle opposite its vertex (opposite the crossing lines), in the direction you want to move it.
Supplementary angles	Drag the selected right angle across the common line.
Corresponding angles	Select a transversal line, then drag an angle along this line onto its corresponding angle to prove that two lines are parallel ("the flying eyes"). If the lines already are proven to be parallel and intersected by a transversal, then drag an angle along the transversal onto its corresponding angle on the parallel line to show that the two angles are equal.
Parallel lines	Parallel lines are marked with "a flying eye". If two parallel lines are marked already, it is then possible to move angles along the transversal line intersecting both parallel lines as described above. If a line A is parallel to a line B and a line C is parallel to line B, then line A and line C must be parallel. In the game we slide the flying eyes on top of each other and they merge, showing all lines parallel.

Getting started with Geometric proofs

Proofs are similar to normal argumentation, where you prove claims using logic based statements that are supported by facts and other relevant evidence.

The focus of geometry is shapes and their properties. Sometimes we have to prove that a shape is in fact the shape we want it to be. In order to prove it, we need to know the properties of each shape and the underlying rules that apply in different situations. Geometric proofs are step-by-step explanations leading to a final conclusion with what you are trying to prove. The students need to use what they know about shapes to suggest steps and state the reason for each step in order to reach the final conclusion. One way of organizing explanations is to use a two-column proof where the statements and conclusions are listed in one column, and the reason for each conclusion is listed in another.

Types of reasons could be:

1) What is given
2) Definitions
3) Postulates and properties
4) Theorems.

In order for students to fully understand the statements and reasons, it is useful to discuss and reflect on the underlying principles. It is useful to plan your steps in a short paragraph or as a simple list.

Let the students describe the different steps in their own words at first, and let them draw and write it down on paper. In this way the students become comfortable discussing geometry and everyone can participate. Gradually, relate the discussion to the curriculum and mathematical vocabulary

How to solve a proof:

1) Read the text carefully and write down what is given and the conclusion you want to prove.

2) Draw an illustration based on the text to help you.

3) Use what you have to set up a plan for how to get to the conclusion. Each step must be shown.

4) Support the steps with reasons, including definitions, postulates, or theorems.

What is a definition?

A definition is an exact explanation of the meaning of a word or phrase in mathematics.

What is a postulate?

A postulate is something suggested or assumed as true as the basis for reasoning, discussion, or belief. A postulate is a statement we accept without proof.

What is a theorem?

A theorem is a statement that has been proven true on the basis of previously established statements.

What is a direct proof?

There are many different ways to establish a proof, but most proofs are done directly, where a series of true statements are used to form a logic-based argument that proves that a final statement is true.

According to this method, take an original statement x, which we assume to be true, and use it to show directly that another statement y is true.

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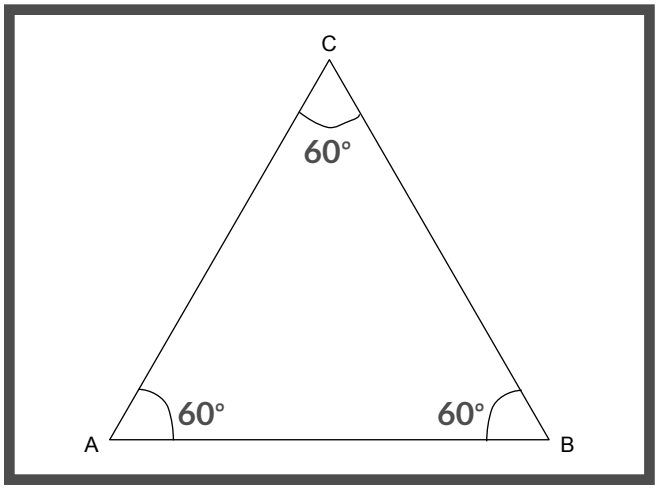
Explore and discuss

Geometric proofs



Assignment: Use the following drawing to prove that the equiangular triangle is also equilateral

Statement	Reason
1. ∠A = ∠B	1. Given
2. AC = BC	2. The converse of the Isosceles Triangle Theorem (if two angles of a triangle are congruent, then the sides opposite those angles are congruent)
3. ∠C = ∠A	3. Given
4. AB = BC	4. The converse of the Isosceles Triangle Theorem (if two angles of a triangle are congruent, then the sides opposite those angles are congruent)
5. AB = BC = AC	5. Based on the transitive property of equality and congruency (of x = y and y = z, then x = z)
6. ΔABC is equilateral	6. All three sides of an equilateral triangle are congruent (of same length)

Chapters 1 and 2:

Lines & Triangles

The triangle is the simplest form of a polygon

A **point** specifies a unique and fixed location. It has no length, size, width, depth, or movement. We usually draw a dot to show a point on paper which has some dimension but a true point has dimension equal 0. In the game, the points are displayed similar to how we would draw them on paper.

Lines are fixed and straight and have only one dimension, which is length. They continue infinitely in two directions, and thus have a infinite length. A line connects two points via the shortest path, and then continues in both directions. On paper, we add some width to a line in order to see it, but a true line has no width. A line contains any point(s) through which it passes. Points that lie on a single line are called **collinear.**

A **line segment** is a part of a line between two points, with two endpoints. It has a finite length, which is the distance between its endpoints.

If two objects have the same shape and size, they are **congruent.** Since segments have a defined length, each segment has a midpoint which divides the segment into two congruent parts.

Shapes consisting of line segments are called *polygons*. The *triangle* is the simplest form of a polygon. Triangles are made up of three line segments or sides and three vertices where the sides meet. The interior angles of a triangle total 180°.

The following are triangle classifications based on sides:

- **Scalene triangle:** A triangle with no congruent sides (three unequal sides)
- **Isosceles triangle:** A triangle with at least two congruent sides (two equal sides)
- **Equilateral triangle:** A triangle with three congruent sides (three equal sides)

A **right triangle/right-angled triangle** is a triangle with one internal angle equal to 90° (chapter 7)

The congruent sides of an **isosceles triangle** are called legs. The point at which these legs meet is called **the vertex point**, and the angle formed is called **the vertex angle.** The other two angles are called **base angles**.

For the **equilateral triangle**, the triangle is **equilateral** if and only if it is **equiangular** (angles are of the same size, measured in degrees), and each angle of an equilateral triangle is 60°. More information about angles can be found on pages 15 and 16.

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Explore and discuss

Lines & Triangles

Typical questions/points for discussion:

1. What is a polygon? Can you give an example of shapes which are not polygons?
2. What is a triangle?
3. What is a quadrilateral?
4. What is an isosceles triangle?
5. What is an equilateral triangle?
6. Why can be double-tap on some figures? What happens when we double-tap? What does this mean?
7. What does congruence mean? When are two shapes congruent?
8. What do the colors in the game mean?
9. What is a proof? Why do we need to prove things in geometry?

Examples of exercises:

1. Draw different polygons and identify the different types of triangles
2. Explore polygons with up to 10 sides. Learn the names of these polygons (triangle/trigon, quadrilateral/tetragon, pentagon, hexagon, heptagon/septagon, octagon, nonagon/enneagon, decagon). What is a megagon?
3. Practice drawing congruent shapes. using colors
4. Do simple proofs together based on levels in the game. Discuss each step. How can we prove that two shapes are congruent?
5. Draw examples on paper from chapter 2 in the game and discuss each step to get to the solution.

Chapter 2: Circles

The circles can help you prove different types of triangles in the game

Definition: A circle is a plane figure contained by one line such that all the straight lines falling upon it from one point among those lying within the figure equal one another and the point is called the center of the circle.

Therefore, the circle consists of all points that are equally far away from the center point.

Postulate: Given any straight line segment, a circle can be drawn having the segment as radius and one endpoint as center.

The distance from the center of the circle to its **circumference** is called the **radius** (plural ***radii***) of the circle. Therefore, any line segment that goes from the center point to the circumference is called the radius. Because any line segment that goes from the center point to the circumference is called the radius, any given circle has an infinite number of radii that are equal in length. In the game, rotating a radius of known length proves that all of the other radii in that circle are the same length.

Circles are named by their center points with a single letter.

Good to know about circles:

All circles are similar because they have the same shape.

Definition: Congruent circles have congruent radii.

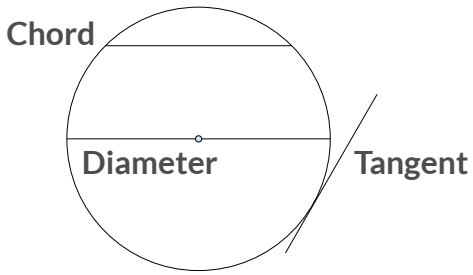
Two or more circles which have the same center point, are called *concentric* circles.

Terminology:

Diameter: The diameter passes through the center point of a circle, and it is the longest chord of the circle (2x radius).

Chord: A chord is a line segment where the endpoints are on the circumference.

Tangent: A tangent is a line which passes through one of the points on the circumference of a circle. This point is then shared by the both the circle and the line.



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Explore and discuss

Circles

Typical questions/points for discussion:

1. What is the radius of a circle? What is the circumference? How is this shown in the game?
2. How could we construct an equilateral triangle based on two circles and a line?
3. What do the colors in the game mean? (reminder)
4. Discuss levels from the game. What can we do with the circle here when we know the radius?

Examples of exercises:

1. Draw examples on paper from chapter 2 in the game and discuss each step to get to the solution.
2. Discuss how you can set up a plan with the steps to get to the solution.

Chapter 3: Angles

Angles can be divided into categories based on their size and special pairs

Angles consist of two rays with a common endpoint (Rays are lines which have an endpoint and go on infinitely in the other direction). The common endpoint is the vertex of the angle. The size of an angle is measured by rotation of one ray from the other and the vertex is the point which the rotation takes place. Angles are measured in degrees.

Isosceles Triangle Theorem: If two sides of a triangle are congruent, then the angles opposite those sides are congruent. So then, if two angles of a triangle are congruent, then the sides opposite those angles are congruent.

Again, for the equilateral triangle, the triangle is equilateral if and only if it is equiangular, and each angle of an equilateral triangle is 60°.

Proposition: If two straight lines cut one another, then they will make the angles at the point of intersection equal to one another.

Definition: When a straight line standing on a straight line makes the adjacent equal to one another, each of the equal angles is right, and the straight line standing on the other is called a perpendicular to that on which it stands.

Special pairs of angles:
Whenever two lines cross, we get two pairs of equal, opposite angles. These pairs are called ***vertical or opposite angles***. These angles are congruent according to The Vertical Angle Theorem.

Adjacent angles are any two angles that share a common side separating the two angles. If the sum of two angles is 180°, these angles are called ***supplementary angles***.

Again, a **right triangle/right-angled triangle** is a triangle with one internal angle equal to 90° (chapter 7).

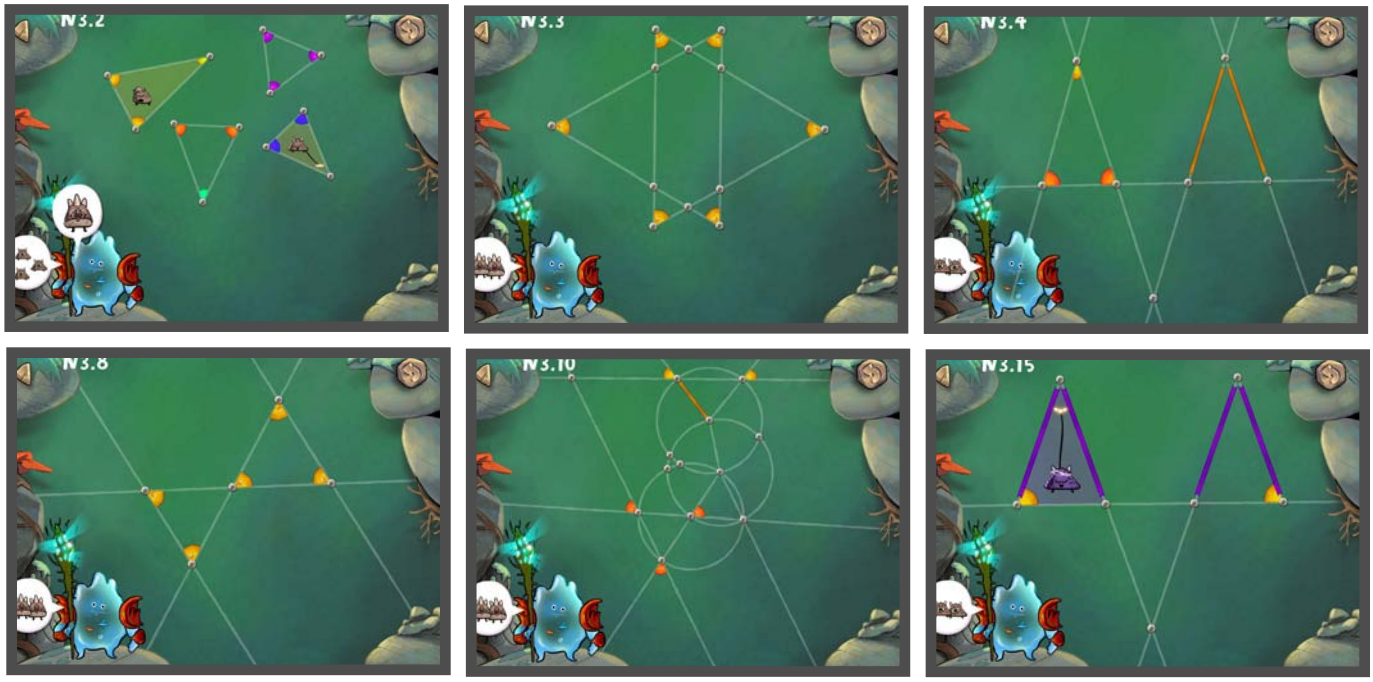
The Isosceles Triangle Theorem states that if two sides of a triangle are congruent, then the angles opposite those sides are congruent. Conversely, if two angles of a triangle are congruent, then the sides opposite those angles are congruent.

For the equilateral triangle, the triangle is equilateral if and only if it is equiangular, and each angle of an equilateral triangle is 60°. Therefore, if a triangle has three congruent sides, then it is given that the triangle is an equilateral triangle, and if the triangle is equilateral, then it also follows that it is equiangular.

In the game, two angles are of equal size if they have the same color.

Explore and discuss

Angles



Typical questions/points for discussion:

1. What do we call the triangles with at least two angles of the same size? If two of the angles are of equal size, what can we say about the legs or sides?
2. What do we call the triangles with three angles of the same size? If three of the angles are of equal size, what can we say about the sides?
3. Why can we “move” the angles? Why do we want to “move” the angles?
4. Which special pairs of angles do we have?
5. (after chapter 7) What is a right-angled triangle and how is this shown in the game?

Examples of exercises:

1. Draw examples on paper from chapter 3 in the game and discuss each step to get to the solution.
2. Draw different isosceles, equilateral, and right-angled triangles using color and add information regarding side lengths and angles.
3. Make a poster of the different special angle pairs.
4. Do simple proofs together based on levels in the game. Discuss each step. Let the students use their own words and then add mathematical terminology. How can we prove that a triangle is equilateral if we know the angles?
5. Perform simple calculations of angle size using what we know about special pairs of angles.

Chapters 4-7: Quadrilaterals

Quadrilaterals can be categorized based on angle size and opposite pairs of sides

A quadrilateral is a polygon with four sides and therefore four vertices. Types of quadrilaterals include squares, rectangles, parallelograms, rhombi, and trapezoids. The interior angles of a quadrilateral total 360° (2 x 180°).

A quadrilateral with two pairs of parallel and equal opposite sides is a parallelogram. Therefore, if both pairs of opposite angles of a quadrilateral are congruent, the quadrilateral is a parallelogram.

A **rectangle** is a quadrilateral with four right angles. A rectangle could also be called a parallelogram with four right angles and two pairs of parallel sides. In addition to the properties of a parallelogram, the rectangle is defined by 1) all four angles are right angles and 2) the diagonals are congruent.

A **trapezoid** is a quadrilateral with exactly one pair of parallel sides.

A **rhombus** is a type of parallelogram with four equal sides. They are sometimes referred to as diamonds. In addition to having the same properties as a parallelogram, 1) the consecutive sides of a rhombus are congruent, 2) the diagonals bisect pairs of opposite angles, and 3) the diagonals are perpendicular.

A **square** is a quadrilateral which is both equilateral (all four sides of the same size) and right-angled (all four angles of the same size, 90°)

Definition: Parallel straight lines are straight lines which, being in the same plane (coplanar) and being extended indefinitely in both directions, do not intersect in either direction.

The transitive property of equality:
If a = b and b = c, then a = c.

Proving parallel lines:
If a line A is parallel to a line B and a line C is parallel to line B, then line A and line C must be parallel through the transitive property of equality.

A **transversal** is a line that passes through two coplanar lines at two different points.

Corresponding Angles Postulate:
If a transversal intersects two parallel lines, the pairs of corresponding angles are congruent. So, if a transversal intersects two lines and the corresponding angles are congruent, then the lines are parallel.

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Explore and discuss Quadrilaterals

Typical questions/points for discussion:

1. What does "parallel" mean? When are two lines parallel?
2. How do we know that two lines are parallel in the game? How can we show that two lines are parallel if it is not given?
3. If a line crosses two parallel lines, what can we say about the angles?
4. What is a square? How do we find a square in the game?
7. What is a rhombus?
8. Discuss the different types of quadrilaterals.

Examples of exercises:

1. Draw examples on paper from chapters 4 - 7 in the game and discuss each step to get to the solution.
2. Make a poster different types of quadrilaterals. Organize them according to similar properties.

Examples

Proofs & Exercises

Chapter1:

1. Discuss and show how a quadrilateral consists of two triangles
2. Discuss and draw different polygons based on this level

Chapter 2:

1. Discuss the properties of different types of triangles based on side length
2. Discuss how we can prove that the triangle is equilateral. Make a plan and discuss the steps. Start setting up a simple proof.

Chapter 3:

1. Prove that a equiangular triangle is also equilateral. Discuss the steps.
2. Prove that the triangle is an isosceles. Let the students describe the steps in their own words and then set up the proof together

Chapter 4:

1. Prove that the quadrilateral is a rhombus. Let the students describe the steps in their own words and then set up the proof together
2. Discuss this level and how to reach the goal.

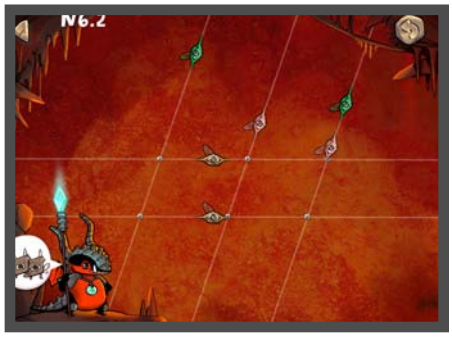
Examples

Proofs & Exercises

Chapter 5:

1. Show why this level consists of three trapezoids/trapezium

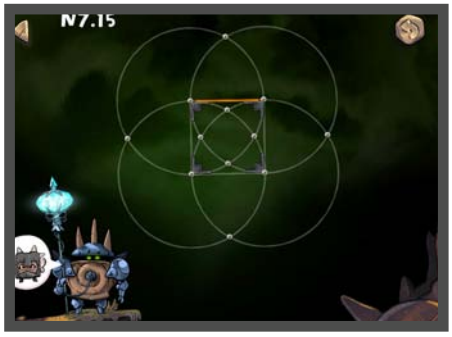
2.Prove the parallel lines and discuss special pairs of angles.



Chapter 6:

1. From what is given, prove that there are two parallelograms in this level.

2. Discuss the steps to reach the goal. How can we prove that the last line is parallel to the other lines?



Chapter 7:

1. How can we prove that this quadrilateral is a square using the radii of the four circles? Discuss.

2. The last level in the game consists of many steps to reach the goal. Discuss the steps and try to set up a plan as a bullet list.