Tangible Programming & Inclusion

TangIn Toolbox
Angles

8-12 years old

Regular Geometric Figures   Probotic

Internal and External Angles

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Summary

Understand the concept of internal and external angle using simple geometric shapes (such as the triangle and square) and infer relations between them and with the number of the polygon sides.

Expected duration: **90 min** (the lesson plan duration is flexible, and teachers can adapt them accordingly to their needs and class duration).

Learning Outcomes

At the end of the session, students are expected to:

- Infer that Mi-GO, when turns, describes, by default, an angle of 90º;

- Remember the main types of angles and the relationships between them;

- Construct regular geometric figures from properties related to their angles - internal and external;

- Conclude that the measure of an angle is independent of the length measure of the respective sides;

- Program the robot adequately;

- Value STEM areas;

- Develop transversal competencies such as problem-solving, communication and reasoning;

- Develop group work skills, namely, to respect and favor the inclusion of all elements regardless of gender, culture, etc.

Links With Curriculum Topics

| Covered Curriculum Topics		
Subject		**Topics**
Engineering	**Mathematics**	Geometry and measure • Properties of geometric figures • Internal and external angles
	Technology	Programming • Concepts of programming • Programs – Results, errors, and troubleshooting Robotics • Programming objects to solve challenges

Notes for Teachers

The teacher should prepare, in advance, all the materials needed and the classroom according to the activities to be developed.

The teams should be as heterogeneous as possible to foster the integration of all students.

It's important that clear rules are established in terms of group work. This way, it avoids the most active children assuming the lead and the quitter ones only observing.

The students must have the previous contact with the concept of angle and with the programming of the robot for its representation.

It's important to explore (informally) the concept of internal and external angles - an external angle is formed by the extension of one side of the polygon and the adjacent side. In the proposed lesson plan, to draw a triangle without having to manipulate manually the robot, the external angle should be used instead (in the case of a regular triangle, 180º - 60º=120º).
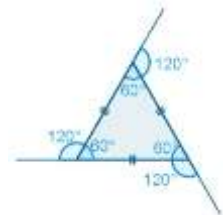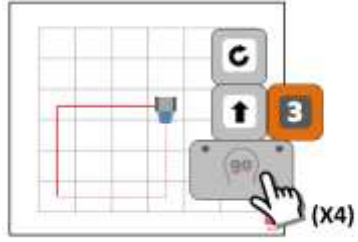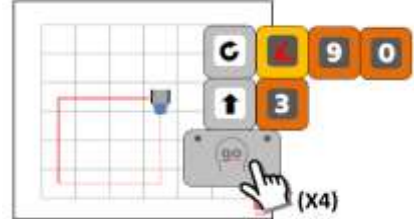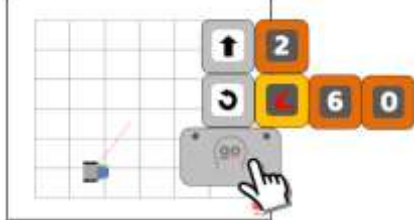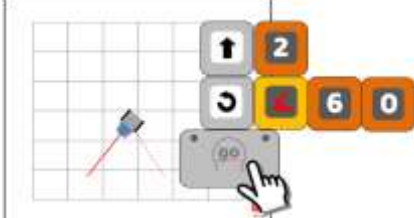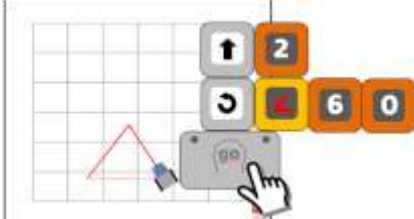
The teacher can guide the students to try to discover the general rule - the measure of the external angle of any given regular polygon will be 360º divided by the number of the respective sides. E.g. triangle: 360º/3 = 120º; square: 360º/4 = 90º; pentagon: 360º/5 = 72º

The teacher must circulate through the various groups to support the activities and the dynamics of each one. In the end, it should promote a collective discussion of the main issues focused and the constraints and difficulties experienced.

Lesson Plan

🎬	🕐	👥	📄	🖼
Intro	10'	Class	"Today's mission is to teach MI-GO how to draw a square and a triangle using angles." Briefly, address the class and discuss the notion of angle and their relationship with geometric shapes.	

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Prep	10'	Group	Divide the class into groups. Give each group a marker, a robot, and blocks, including the angle block. Ask the groups to draw a 3x3 square without using the angle block. Firstly, step by step and, after, all at once.	
Play	10'	Group	Repeat the task but this time using the angle block. Students should conclude that the turn block, by default (when not using angle blocks) turns 90º.	
Play	10'	Group	Now, ask the groups to draw a regular triangle. Place the robot on the map and use the following code to turn 60º and move forward 2 times.	
Play	5'	Group	Pick the robot and place it in corner aligned with the previously drawn line. Use the following code and execute it.	
Play	5'	Group	Repeat the same procedure to finish drawing the triangle.	

▶	🕐	👥	📄	🖼
Play	30'	Group	Now, challenge the (older) groups to draw a regular triangle all at once. It's time to discuss the concept of the external angle. Now, challenge the (older) groups to draw a regular pentagon, hexagon, … all at once.	
Discussion	10'	classe	Finally, discuss and infer the relation between i) the measures of internal and external angles and ii) external angel measure and the number of the polygon sides.	

Resources List & Support Material

Per each group:

- A robot Kit with drawing capabilities;

- Markers for each group (easy to erase/clean);

- Alcohol for cleaning the scenarios (for teacher use only);

- Transparent scenario with a 6x6 grid; 2X Shape cards (Annex).