# Teaching & Learning Plans

## Plan 7: Introduction to Angles

### Junior Certificate Syllabus

Project Maths Tionscadal Mata
Development Team

# The Teaching & Learning Plans are structured as follows:

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**Aims** outline what the lesson, or series of lessons, hopes to achieve.

**Prior Knowledge** points to relevant knowledge students may already have and also to knowledge which may be necessary in order to support them in accessing this new topic.

**Learning Outcomes** outline what a student will be able to do, know and understand having completed the topic.

**Relationship to Syllabus** refers to the relevant section of either the Junior and/or Leaving Certificate Syllabus.

**Resources Required** lists the resources which will be needed in the teaching and learning of a particular topic.

**Introducing the topic** (in some plans only) outlines an approach to introducing the topic.

**Lesson Interaction** is set out under four sub-headings:

i. Student Learning Tasks – Teacher Input: This section focuses on teacher input and gives details of the key student tasks and teacher questions which move the lesson forward.

ii. Student Activities – Possible and Expected Responses: Gives details of possible student reactions and responses and possible misconceptions students may have.

iii. Teacher's Support and Actions: Gives details of teacher actions designed to support and scaffold student learning.

iv. Checking Understanding: Suggests questions a teacher might ask to evaluate whether the goals/learning outcomes are being/have been achieved. This evaluation will inform and direct the teaching and learning activities of the next class(es).

**Student Activities** linked to the lesson(s) are provided at the end of each plan.

# Teaching & Learning Plan 7: Introduction to Angles

Project Maths Tionscadal Mata Development Team

## Aims

- To introduce students to the concept of an angle as a rotation and naming an angle
- To help students to learn about various angle types and the measurement of angles (In degrees)
- To help students to recall and/or deepen their understanding of the concepts of parallel and perpendicular lines and horizontal and vertical lines

## Prior Knowledge

Students should understand and recall the concepts of planes, points, etc. introduced in Teaching and Learning Plan 6. They should be familiar with the circle as a shape.

## Learning Outcomes

As a result of studying this topic, students will be able to

- recognise angles in terms of rotation
- classify and describe angles
- describe the various angle types in terms of degrees
- relate angles to shape
- name an angle
- identify and name parallel and perpendicular lines, vertical and horizontal lines

## Relationship to Junior Certificate Syllabus

| Sub-topics | Ordinary Level |
|---|---|
| 2.1 Synthetic geometry<br>The geometrical results should be first encountered through discovery and investigation. | (Refer to the appendix on geometry)<br>**Terms:** Angle; Rotate; acute, right angle, obtuse, straight angle, reflex angle, ordinary angle; circle, perpendicular lines<br>Concepts (introduced as required)<br>Constructions: 1, 2, 3, 4, 5, 6, 8, 9, 10, 11<br>Theorems: non-rigorous treatment of theorems 1 – 6. |

## Resources Required

Geostrips and geometry sets for each student

## Introducing the Topic

Students may well have some misconceptions about angles, which will need to be explored and overcome:

- the size of an angle varies with the length of the arms
- the size of an angle varies with the size of arc made with the angle vertex as centre
- different orientations of an angle as a source of confusion
- that a right angle only exists between vertical and horizontal lines

| Lesson Interaction | | | |
|---|---|---|---|
| **Student Learning Tasks: Teacher Input** | **Student Activities: Possible and Expected Responses** | **Teacher's Support and Actions** | **Checking Understanding** |
| » Today's class is all about angles. You meet angles everywhere you go – all sorts and sizes of angles in buildings and rooms and even in natural things. Let us start by talking about how an angle is made. When we have two rays in the same place in the plane ("on top of each other"), and we rotate (or turn) one about some common point, while the other stays where it is, we get an angle, just like these two geo-strips here. As you can see when we rotate one strip, we get an angle. The angle is the amount of rotation that is done. | | » Start a "new words" section on the board. Insert the word "ANGLES".<br><br>» Demonstrate the concept of angle by using two (long red) Geostrips fastened together at one end. The strips will be on top of each other at first, then the top one is slowly rotated to reveal an angle. Put major emphasis on the ROTATION part of this motion. | |
| | » Students fasten Geostrips (of same colour and length) together and rotate. | » Give each student two Geostrips: two of the same colour and length and an additional two strips of a different colour and length to the previous two. | » Are students moving the Geostrips in a way that shows they understand the term 'rotate'? |

 

| Student Learning Tasks: Teacher Input | Student Activities: Possible and Expected Responses | Teacher's Support and Actions | Checking Understanding |
|---|---|---|---|
| » Do you understand the meaning of "rotate"?<br><br>» Can you give me another word meaning the same? | • Turn…twist. | » Write the word ROTATE on the board in the "new words" list. | |
| » Can you give examples of things that you have seen rotating? | • Bottle top, steering wheel of car…your arm…your leg. | | |
| » What about when we open the door? The door rotates around the hinges, does it not? See how the door makes an angle with the wall as I rotate it. | | » Go to the classroom door and open it. An angle forms between the door and some wall. | |
| » Now let us rotate the strip further; we get a bigger angle. If we rotate more, we get a bigger angle still. | » Students rotate Geostrips. | » Rotate the top Geostrip further to make a bigger angle, then vary the amount of rotation to emphasise the point. | » Are students sure what it means for something to rotate? |
| » The key thing here is that the angle is the rotation of one ray about another ray through a common point. The angle changes as we change the amount of rotation. | | | |
| » The two rays which make up the angle are called the arms of the angle. | | » Draw an angle on the board and indicate the rays as arms of the angle, and adds "ARMS of the ANGLE" to the "new words" list. | |

 

| Student Learning Tasks: Teacher Input | Student Activities: Possible and Expected Responses | Teacher's Support and Actions | Checking Understanding |
|---|---|---|---|
| » Now let us see what happens if we change the length of the strip we use to make the angle. Let us rotate the shorter strip at the same time as the larger. Does this change the size of the angle? | • No | » Use two shorter (yellow for contrast) strips. Rotate one of these and one of the longer red strips simultaneously to show that the amount of rotation and therefore angle size, is unaffected by the length of strip used. | |
| » Do you agree or disagree with this? | | » Invite students to agree or disagree, but explain they must have a valid reason for so doing. | » Are you satisfied that the explanations students give you, show that the length of the arms of the angle do not dictate the size of the angle? |
| » Can you see that the amount of rotation of the larger strip is the same as the amount of rotation of the longer strip? | » Students mirror with their geostrips what the teacher has demonstrated. | | |
| » Now have a look at these two angles on the board. They have the same degree of rotation, but the arcs are different sizes. Are these angles the same size or is one bigger than the other? | • They are the same size because they both have the same degree of rotation. | » Draw two equal angles on the board, but insert different sized arcs on each.<br><br>» Ask the class and give them a moment to think before asking one student. | » Can the students explain clearly why the two angles are the same size even though the arcs are different sizes? |

| Student Learning Tasks: Teacher Input | Student Activities: Possible and Expected Responses | Teacher's Support and Actions | Checking Understanding |
|---|---|---|---|
| » Now let us rotate the strip further.<br><br>» Do you know what we call this angle? | » Students mirror with their geostrips what the teacher has demonstrated.<br><br>• Acute angle. | » Use the red (longer) strip to show an acute angle.<br><br>» Ask the class and give them a moment to think before asking one student. | |
| » Yes. Notice how sharp the point of the angle looks. "acute" means "sharp". | | » Write the words ACUTE ANGLE on the board. | |
| » Have you met the word "acute" before? Where? | • Acute appendicitis, acute shortage etc… | | |
| » Where the two arms meet is called the VERTEX of the angle. | | » Indicate on Geostrips where the vertex is.<br><br>» Write the word VERTEX on the board. | |
| » Now let us rotate the strip further. | | » Move the strip to the vertical position to show a right angle. | |
| » Do you know what we call this angle? | • A right angle (some may say 90°). | » Ask the class and give them a moment to think before asking one student. | |
| » Why do you think this is called a right angle? | • Students may say because it is…"upright"? | | |
| » The word "right" has many meanings in English. | | » Brief class discussion of the meaning of the word right in the English language.<br><br>» Write the words "RIGHT ANGLE" on the board in the "new words" list. | » Are students actively participating in the discussion? |

 

| Student Learning Tasks: Teacher Input | Student Activities: Possible and Expected Responses | Teacher's Support and Actions | Checking Understanding |
|---|---|---|---|
| » Now if I were to turn the same size angle the other way, would I call it a "left angle"? | • No<br><br>» Students mirror with their geostrips what the teacher has demonstrated. | » Turn the angle round so that the right angle is on the left as seen by the students.<br><br>» Ask the class to explain why. | » Are any students having difficulty with the new words? |
| » Now let us rotate the strip even further. | | » Move the strip to the position to show an obtuse angle. | |
| » Do you know what we call this angle? | • An obtuse angle. | » Ask the class; then select an individual student to answer.<br><br>» Write the words OBTUSE ANGLE on the board. | |
| » Notice how the point of the angle looks less sharp. "Obtuse" means "blunt". Have you met the word "acute" before?<br><br>» Students may not have met this word before in other conversation? | | | |
| » Now let us rotate the strip further. | » Students mirror with their geostrips what the teacher has demonstrated. | » Move the strip to the position to show a reflex angle. | |
| » Do you know what we call this angle? | » A reflex angle | » Ask the class; then select an individual student to answer.<br><br>» Write the words REFLEX ANGLE on the board. | |

 

| Student Learning Tasks: Teacher Input | Student Activities: Possible and Expected Responses | Teacher's Support and Actions | Checking Understanding |
|---|---|---|---|
| » Now let us rotate the strip further until we come back to where we started. | » Students mirror with their geostrips what the teacher has demonstrated. | » Move the strip to the position where it started. | |
| » Now we are back where we started and we have done a full revolution which means that the end of the strip has completed a full circle. | | | |
| » Look around the classroom and identify where angles are formed. What kind of angles are they? Which is the most common angle and which is the least common angle? | » Students look for angles in the room and write a number of them into their copies. | » Walk around to see what students are writing down. Some students may have difficulty. As you walk around identify and guide those students. | » Has everyone completed the task? |
| » Now we must talk of measuring angles.<br><br>» Does anyone know what unit we use to measure angles? | • Degrees | » Ask the class; then select an individual student to answer. | |
| » How many degrees in a full circle? | • 360° | » Ask the class; then select an individual student to answer. | |
| » This is a funny number to have for a full circle is it not? Well, the reason for this goes back to the ancient Babylonians of 2000 B.C. and their way of measuring the time in a day. | | | » Are students actively participating? |

 

| Student Learning Tasks: Teacher Input | Student Activities: Possible and Expected Responses | Teacher's Support and Actions | Checking Understanding |
|---|---|---|---|
| » Let us look again at the strips as we make the various angles. | | » Prepare to demonstrate various angle sizes using board and geo-strips. Move the strip to the vertical position to show a right angle. | |
| » How many degrees in a right angle? | • 90° | » Ask the class; then select an individual student to answer. | |
| » Why? | • Because at this point we are one quarter of the way to a full circle and 90° =1/4 of 360°. | | |
| » How many degrees in a straight angle? | • 180° | » Move the strip to the position to show a straight angle. | |
| » Why? | • Because at this point we are half-way to a full circle and 180°= ½ of 360°. | » Ask the class; then select an individual student to answer. | |
| » There is a name for two lines which are at an angle of 90° to each other. Do you know this name? | » Students mirror with their geostrips what the teacher has demonstrated.<br>• Perpendicular lines | » Move the strip to the position to show a straight angle.<br>» Ask the class; then select an individual student to answer. | |
| » Yes they are called perpendicular lines.<br>» Remember you must have at least two lines to compare if you want to use the word "perpendicular". | | » Write the words PERPENDICULAR LINES on the board in the "new words" list. | |

 

| Student Learning Tasks: Teacher Input | Student Activities: Possible and Expected Responses | Teacher's Support and Actions | Checking Understanding |
|---|---|---|---|
| » Can you see any lines perpendicular to each other in this room? | » Students look for perpendicular lines in the room and write a number of them into their copies. | » Walk around to see what students are writing down. Some students may have difficulty. As you walk around identify and guide those students. | » Has everyone completed the task? |
| » What do you call two lines which are always the same distance apart? | • Parallel lines. | » Move the strips to the position to show parallel lines.<br><br>» Ask the class; then select an individual student to answer.<br><br>» Write the words PARALLEL LINES on the board in the "new words" list. | |
| » Can you see any lines parallel to each other in this room? | » Students look for parallel lines in the room and write a number of them into their copies. | » Walk around to see what students are writing down. Some students may have difficulty. As you walk around you identify and guide those students. | » Has everyone completed the task? |
| » What is the name for a line which goes straight up and is perpendicular to the ground? | • A vertical line | » Ask the class; then select an individual student to answer.<br><br>» Write the word VERTICAL on the board in the "new words" list. | |
| » What is the name for a line which is level and runs parallel to the ground? | • A horizontal line | » Write the word HORIZONTAL on the board in the "new words" list. | » Do students understand these words? |

 

| Student Learning Tasks: Teacher Input | Student Activities: Possible and Expected Responses | Teacher's Support and Actions | Checking Understanding |
|---|---|---|---|
| » Finally we want to name an angle. We name an angle by the three letters which give the two rays that make up the angle, so that the point denoting the vertex is in the middle. | | » Demonstrate naming an angle on the board using three letters in two ways, for example <ABC or <CBA. | |
| » Working in pairs, complete **Student Activity 1**. | » Students fill out **Student Activity 1**. | » Distribute **Student Activity 1**.<br><br>» Walk around to see what students are writing down. If anyone is struggling, ask questions which will give them a hint of an example. | » Did students have lots of different suggestions? |
| | » Students copy different ideas to their own from the board. | » Take selections from each group and record them on the board/flipchart/laptop. | |
| » Complete **Student Activity 2 and 3**. | » Students fill out **Student Activity 2 and 3.** | » Distribute **Student Activity 2 and 3**.<br><br>» Circulate and support students who have difficulty with the task. | » Do students understand the words, phrases and diagrams? |

| Student Learning Tasks: Teacher Input | Student Activities: Possible and Expected Responses | Teacher's Support and Actions | Checking Understanding |
|---|---|---|---|
| **Reflection**<br><br>» Write down 3 items you learned about angles and lines today.<br><br>» Write down anything you found difficult.<br><br>» Write down any question you may have. | 1. There are many sizes of angles: acute, right, obtuse, straight and reflex.<br><br>2. A full circle has 360 degrees.<br><br>3. Two lines that meet at 90 degrees to each other are called perpendicular lines.<br><br>4. Angles are named using three letters with the vertex in the middle.<br><br>5. Lines which are always the same distance apart are called parallel lines.<br><br>6. A line which goes straight up and is parallel to the ground is called a vertical line.<br><br>7. A line which is level and runs parallel to the ground is called a horizontal line. | » Circulate and take note particularly of any questions students have and help them to answer these. | |

# Student Activity 1

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**Students work in pairs.**

1. **Find and list 5 surfaces in the classroom which are horizontal and 5 which are vertical.**

2. **See if you can find lines or surfaces which are parallel.**

3. **See if you can find lines or surfaces which are perpendicular to each other.**

4. **Can you find perpendicular lines in the classroom where the lines are not vertical or horizontal?**

5. **What type of lines are used in the pages of your copy?**

6. **Why is it important to have walls vertical?**

7. **Is it important to have floors horizontal? Why?**

8. **Do you know what a builder uses to ensure that he builds a wall vertically?**

9. **What building in Italy is famous for not being vertical?**

 

# Student Activity 2

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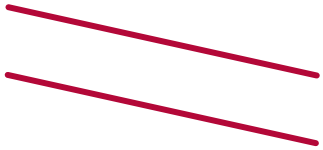
Look at the mathematical words/phrases in the middle column below and rewrite each into the correct description box on the left and diagram box on the right.

| Description | Mathematical words/ phrases | Diagram |
|---|---|---|
| Line going directly upwards | Horizontal Line |  |
| Angle greater than 90° but less than 180° | Acute angle |  |
| Line parallel to the ground | Right Angle |  |
| Angle of 180° | Obtuse Angle |  |
| Angle greater than 180° | Straight Angle |  |
| Angle of 90° | Reflex Angle |  |
| Angle less than 180° | Ordinary Angle (more than one diagram) |  |
| Lines which never meet | Perpendicular Lines |  |
| Lines at an angle of 90° to each other | Parallel lines |  |
| Angle less than 90° | Vertical line |  |

# Student Activity 3

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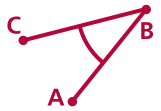
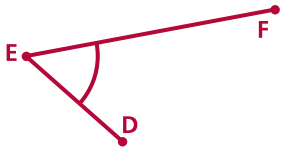
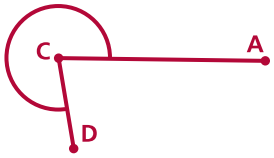
1. **Name each of these angles using three letters in two ways:**

| Angle | Name one | Name two |
|---|---|---|
|  | | |
|  | | |
|  | | |
|  | | |

2. **What is a wide-angle lens in a camera? What does it do? What type of picture does it take?** _____

3. **What does it mean when we say that in football that "the goalkeeper narrowed the angle"? What angle did the goalkeeper narrow?** _____

4. **Draw out the last five letters of the alphabet in capitals. What kinds of angles are formed in them?** _____

5. **What kinds of angle are formed by the hands of a clock?**
   **(a) At 9.00p.m?** _____
   **(b) At 6.00 a.m.?** _____
   **(c) At 3.00 a.m.?** _____

6. **Through how many degrees will the minute hand of a clock rotate in:**
   **(a) 30 minutes?** _____
   **(b) 20 minutes?** _____
   **(c) 40 minutes?** _____
   **(d) 45 minutes?** _____