# Lesson Research Proposal for Co-ordinate Geometry

For the lesson on 24<sup>th</sup> January 2017 At Ballinode Community College Siobhàn Gordon's, 2<sup>nd</sup> year mixed ability class Instructor: Siobhàn Gordon Lesson plan developed by: Siobhan Gordon, Aoife Rooney,

### 1. Title of the Lesson: Meet You Halfway

#### 2. Brief description of the lesson

The lesson will consist of students being given a photograph of Sligo town with a coordinate grid superimposed on it. They are asked to find the centre-point of pairs of various given locations.

#### 3. Research Theme

At Ballinode Community College we want our students

- To enjoy their learning, be motivated to learn, and expect to achieve as learners
- Grow as learners through respectful interactions and experiences that are challenging and supportive.

As mathematics teachers we will actively achieve these goals by

- Selecting and using planning, assessment and preparation practices that progress students learning
- Responding to individual learning needs and differentiate teaching and learning activities as necessary

#### 4. Background & Rationale

- a) This lesson is aimed at second year students. The teaching of co-ordinate geometry has become procedural and students lack the knowledge of the concepts involved. Students have an understanding of co-ordinate geometry from primary school and first year and this needs to be deepened in a problem solving way. We recognize that when tackling problems, students experience difficulty in changing concrete situations into a mathematical statement. From our experience we have noted that students encounter significant difficulty in using formulae because of their lack of understanding of the origin of the formula. For these reasons when it comes to teaching coordinate geometry we cannot simply teach it as a procedure, rather students must have a good understanding on the concepts of geometry and substitution as well as the methods to manipulate them.
- b) Your research findings

Through discussions with members of the maths department we realize that our teaching of coordinate geometry is imbalanced towards a procedural approach. It is rare that students are given time to understand the concepts behind the formulae used in coordinate geometry and

how they relate to real life situations.

### 5. Relationship of the Unit to the Syllabus

Related prior learning Outcomes	Learning outcomes for this unit	Related later learning outcomes
<ul> <li>In 3<sup>rd</sup> and 4<sup>th</sup> class students:</li> <li>Identify lines of symmetry</li> <li>Identify oblique and perpendicular lines</li> </ul>	<ul> <li>Investigate and understand the midpoint of a line segment</li> </ul>	<ul> <li>Investigate and understand the equations of a line (relationship between perpendicular and parallel)</li> </ul>
<ul> <li>Solve problems involving lines and angles</li> </ul>	<ul> <li>Slope of a line segment</li> </ul>	Rate of change
<ul> <li>In 5<sup>th</sup> and 6<sup>th</sup> class students</li> <li>plot simple coordinates</li> <li>apply where appropriate</li> </ul>	<ul><li>Length of a line segment</li><li>Equations of a line</li></ul>	<ul> <li>Relationship between rate of change and the slope</li> </ul>
In first year the students	Intersection of lines	<ul> <li>Solving Simultaneous Equations</li> </ul>
understand how to coordinate the plane		<ul> <li>Perpendicular Bisector of a line segment</li> </ul>
<ul> <li>Investigate and understand how to locate points on the plane using coordinates</li> </ul>		Circumcentre of a triangle

### 6. Goals of the Unit

- Students will understand that some type of problems do not have a single approach rather there are many set of approaches to solve the problem
- Students will recall basic facts related to geometry
- Students will use their prior knowledge regarding plotting points on a coordinate plane
- Students will understand the concept of midpoint, line segment, slope, distance between two points and intersection of two lines
- Students will explore the properties of points and line segments
- Students will apply a variety of approaches to locate the midpoint of a worded problem
- Students will generalise an approach to finding the midpoint, slope of a line segment and distance between two points on a line.
- Students will have the opportunity to interpret information presented in graphical and pictorial form
- Students will understand that situations involving distance, midpoint, slope, etc., may be expressed both algebraically and graphically
- Students will be confident in their abilities to select the correct formula/approach to solve problems
- Students will actively engage with the digital strategy

### 7. Unit Plan

Lesson	Learning goal(s) and tasks
1	Pythagoras' Theorem
2	Activities on the coordinate plane – 4 quadrants
3	Research lesson – focused on the midpoint of two points
4	Mid Point discussion and application
5	Slope, perpendicular and parallel lines
6	Slope
7	Slope
8	Distance between two points
9	Distance between two points
10	Distance between two points
11	Equation of a line
12	Equation of a line
13	Equation of a line
14	Intersection of lines

#### 8. Goals of the Research Lesson:

a) Mathematical Goals

Students will:

- Understand the concept of midpoint
- Explore the properties of points and line segments
- Apply a variety of approaches to locate the midpoint of a worded problem
- Generalise an approach to finding the midpoint of a line segment.

#### b) Key Skills and Statements of Learning

In the planning and design of this lesson the Junior Cycle Key Skills and Statements of have been considered. This lesson will implement and promote JC Key Skills in the following ways:

- 1. Being Literate: Students will have the opportunity to express their ideas clearly and accurately.
- 2. Being numerate: It will develop a positive disposition towards problem solving
- 3. Managing myself: Students will have the opportunity to reflect on their own learning
- 4. Staying Well: Students confidence and positive disposition to learning will be promoted
- 5. Communicating: Students will present and discuss their mathematical thinking
- 6. Being Creative: Students will explore options and alternatives as they actively participate in the construction of knowledge
- 7. Working with others: students will learn with and from each other
- 8. Managing information and thinking; students will be encourages to think creatively and critically.

This lesson is also designed to meet the following JC Statements of Learning in particular:

1. The student communicates effectively using a variety of means in a range of contexts 15. The students recognizes the potential uses of mathematical knowledge, skills and

understanding in all areas of learning

16. The students describes, illustrate, interpret, predicts and explains patterns and relationships17. The students devises and evaluates strategies for investigating and solving problems using mathematical knowledge, reasoning and skills

18. The student observes and evaluates empirical events and processes and draws valid deductions and conclusions

## 9. Flow of the Research Lesson

Teaching Activity	Visual	Points of consideration
Introduction 5 mins Recap prior knowledge		You all have maps on the table. Can anyone tell me what town this is? Are there any places you recognize on the map?
Pose the problem 10 mins		Can everyone find Abbey Street Bus Stop? Can anyone tell me the co- ordinates of the Abbey Street bus stop? Is there any other point that is relevant to the question? Can everybody find Penney's on O'Connell Street? What are the coordinates of Penney's? Is everybody sure about what they are being asked to do? Clarify halfway in between if necessary. 'Each table has a pack and copies of the grid. I'd like you to find in as many ways as you can where they will meet? You have 10 mins

Anticipated Student	Visual	Teacher support
1. Bisect		Explain how you did this Do you know what this method is called? Can anyone explain what the word bisect means? Clarify what it means to bisect a line if necessary. Using this method where will they meet? Water Lane.
2. Measuring		Explain how you did this I joined up the two points and measured it with a ruler. I got 10.2 so then I halved it and got 5.1. Then I used a ruler to measure 5.1. Where will they meet? <i>Water Lane.</i>
<ol> <li>Count over and count down</li> </ol>		Explain how you did this I counted over the x axis and divided it in two. Then I counted up the y-axis and divided it in two. Where did you end up? Water Lane.
4. Visual		Explain how you did this I looked and guessed what was half way – I'm down at the river somewhere

5. Using co- ordinate points		Explain how you did this I looked at the two coordinate points. I added the x coordinates and divided it by two. Then I looked at the two y coordinates and divided it by two. I ended up with (-0.5, 2). Where did you end up? Water Lane
End of problem 1 discussion 5 mins		What is common in most of these solutions? <i>Water Lane</i> Which method is most accurate? 5 Why? Because it tells you exactly where to go – if it was busy you'd be able to find someone
<b>Problem 2</b> 5 mins	It is Mark's birthday and his family take him to Eala Bhan to celebrate. Thomas has been at the cinema to celebrate thomas the source of th	Ok let's look at our 2 <sup>nd</sup> problem. Where is Eala Bahn? What are its' coordinates? Where is the Omniplex? What are its' coordinates? Stress that it is the coordinates of the location that are required this time Which method do you think will be best to use? Which method is more accurate? We are all going to use method 5 This method is add the x coordinates and half them, then add the y coordinates and half them. Is everyone OK with this? Let's look at our co-ordinates – who can tell me which numbers are x? Which are y? Are these natural numbers? What are they? Integers What do we use when we are adding integers?

		A numberline. There's a numblerline on every desk and a calculator too
Anticipated student response 10 mins		Incorrect Answer Can you show me where you found on the map please. Does that look like Halfway? Where do you think you went wrong? Integers can sometimes cause us problems. Correct Answer Can you show me where you found on the map please? Locate these coordinates on you map. Does this seem accurate?
Problem 3 8 mins	Paul is at AlB and is meeting his         Triend Jasmine halfway at Sweet         Dasmine's starting point?    Paul is at AlB and is meeting his friend Jasmine halfway at Sweet Beat. What are the co-ordinates for Jasmine's starting point?	What is different about this question? We are told where they are meeting. We need to find Jasmine's starting point

Homework Question 5 mins	Homework Problem	Can everyone please take a picture of the homework question.
	$\left(\frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2}\right)$ Explain this in relation to what you did today.	Does everyone understand what is being asked?
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Exit Question		On the post-it can you please
2 mins		put one thing you learned and
		one question you have.

### 10. Board Plan



#### Actual Board Work





#### Exit question responses



#### **Evaluation**

- All the goals of the lesson were achieved
- Students reflected on their learning through the use of the exit ticket which they did very well
- Timing went very well Ceardiocht was in progress at allotted time
- Use of integers led to a richer learning experience and misconceptions were addressed as they arose
- As students were familiar with the geographical area the engaged with the task fully and the location of Water Lane as the answer for problem one was very accurate

#### 11. Reflection

- We were surprised at how many used the bisecting method
- Over half of the students measured
- No student used count up and count over
- Lots of students used the visual method-guessing however after clarification they then veered away

from it

One student created a rectangle, drew diagonals and where they intersected found the co-ordinate point



- Students did not assume that problem three was the same as one and two they really listened , read and understood
- We feel that the homework will be well achieved
- It is very important that the two points with a line to enforce that the point required is in between the two given points
- The board space needs to be expansive
- The time taken for students to engage with the problem initially could be extended
- The time of 1 hour was felt to be very good

#### **The Problem**

# **Meet you Halfway**

- Stacey takes the bus in from Cartron and gets of the bus at Abbey Street. Fiona is at Pennys on O'Connell Street. They ring each other and decide to meet halfway in between. Where will they meet? How many ways can you find where they will meet?
- 2) It is Mark's birthday and his family take him to Eala Bhan to celebrate. Thomas has been at the cinema to celebrate his birthday! They Snapchat each other and agree to meet halfway. What are the co-ordinate's of where they will meet?
- 3) Paul is at AIB and is meeting his friend Jasmine half way at Sweet Beat. What are the coordinates for Jasmine's starting point?
- 4) Homework problem:

Consider this formula

$$\left(\frac{x_1+x_2}{2},\frac{y_1+y_2}{2}\right)$$

Explain this in relation to what you did today.

