Lesson Research Proposal for 2017/2018: Real life graphs 2nd Year

For the lesson on 24th January 2018
At Drogheda Grammar School, Ms. Doherty's 2nd Year Class
Instructor: Michelle Doherty
Lesson plan developed by: Samantha Boyle and Michelle Doherty

1. Title of the Lesson: It's thirsty work: Graphing and Interpreting a Graph from a Real Life Event.

2. Brief description of the lesson

In this lesson, students will draw graphs depicting the constant flow of a liquid into three different containers.

3. Research Theme

a) Students enjoy their learning, are motivated to learn and expect to achieve as learners
b) Support and encourage the students to problem solve
c) Students grow as learners through respectful interactions and experiences that are challenging and supportive

As a Maths department, we will actively support the achievement of these goals in the following ways:

a) The teacher selects and uses planning, preparation and assessment practices that progress students' learning
b) Teachers value and engage in professional development and professional collaboration
c) Teachers work together to devise learning opportunities for students across and beyond the curriculum
d) As a department we have agreed that our emphasis will be on graphing as part of the School Self-Evaluation in the area of numeracy

4. Background & Rationale

This lesson is aimed at second- year students. The teaching of graphing is an important concept for students to grasp. As a whole school we have put an emphasis on graphing and as such we want the students to see the connections between Coordinate Geometry, graphing equations, real-life graphs and Algebra.

It is commonly recognized that when tackling problems mathematically, students experience difficulty in connecting them to the real world. For these reasons when it comes to drawing and interpreting real-life graphs we will adopt a structured problem solving lesson approach.

This links in with other subjects. There is a cross-curricular element in relation to Business, Science, Geography and many other subjects.

5. Relationship of the Unit to the Syllabus

Related prior learning Outcomes	Learning outcomes for this unit	Related later learning outcomes
In Infants through to sixth class the students learn to: — Recognize and	Using graphs to represent phenomena quantitatively, students will be able to:	— Interpret simple graphs — Plot points and lines Draw graphs of the following functions and

interpret data from tables, graphs and diagrams — Organize and represent data on graphs and pictures In first year the students learn to: — Find, collect and organise data — How to represent the data graphically and numerically — How to represent situations with tables, diagrams and graph	— Explore graphs of motion — Make sense of quantitative graphs and draw conclusions from them — Make connections from the shape of the graph and the story of the phenomenon — Describe both quantity and the change of quantity on the graph	interpret equations of the form f(x) = g(x) as a comparison of functions: $f(x) = ax + b$ $f(x) = ax^2 + bx + c$ — Use graphical methods to find approximate solutions where f(x)=g(x) and interpret the results — Graph solution sets on the number line for linear inequalities in on variable

6. Goals of the Unit

a) Students will explore graphs of motion using real-life examples
b) Students will understand quantitative graphs and make deductions from them
c) Students will make connections between the shape of the finished graph and the story behind it
d) Students will have the ability to describe quantity and change in quantity on the graph
e) Students will be confident in exploring graphs and using them to represent information in Maths, Science, Geography and other subjects.
f) Students will recognize the potential uses of mathematical knowledge, skills and understanding in all areas of learning

7. Unit Plan

Lesson	Learning goal(s) and tasks
1	Revision of the concept of graphing, i.e. scale, axis, label and title, as well as the distance-speed-time formulas. Introduce the distance-time graphs that will enable the students to make connections from the shape of the graph and the story behind it. This will also give the students an opportunity to explore graphs of motion.
2	Directly proportional graphs. Students will notice after a number of graphs are shown that when two quantities are in direct proportion, a graph will illustrate how one quantity increases or decreases relative to the second quantity. This will help the students make sense of quantitative graphs and draw conclusions from them. Students can describe the quantity and the change of quantity on the graph.

3 The Research Lesson	A problem-based approach will be adopted for the research lesson. To start the lesson, there will be a quick recap of the students' prior knowledge of graphing in the previous two lessons. Use a suitable problem to a) Challenge the students to make connections from the story of an event to draw a graph b) Encouraging students to draw knowledge from other subjects Students will be given a similar problem to complete for homework to reinforce learning
4	To reinforce the learning outcomes of the previous lessons, students will be given problems to solve that involve drawing and interpreting real-life graphs. Use GeoGebra to give students an interactive exercise where they will see the depth-time graphs of different shaped containers

8. Goals of the Research Lesson:

a) Mathematical Goals:

- Students will explore graphs of motion using real-life examples
- Students will understand quantitative graphs and make deductions from them
- Students will make connections between the shape of the finished graph and the story behind it
- Students will have the ability to describe quantity and change in quantity on the graph
- Students will be confident in exploring graphs and using them to represent information in Maths, Science, Geography and other subjects.

b) Key Skills of the lesson should refer to:
As a Maths department we are integrating the development of Junior Cycle Key Skills into our Maths lessons. This lesson will address the following Key Skills:

1. Being Literate: With the help of Ceardaíocht, where students compare and discuss their ideas, they can express their ideas clearly and accurately
2. Being Numerate: The problem task will help the students develop a positive attitude towards investigating, reasoning and problem-solving.
3. Communicating: During Ceardaíocht, students have the opportunity to present and discuss their mathematical ideas.
4. Being Creative: Students can explore options and alternatives as they engage in a task for which they have to come up with the solution that is not immediately obvious.
5. Managing information and thinking: Students will think creatively and critically where they engage in a problem task which requires them to use their mathematical knowledge and skills.
6. Managing myself: Students can reflect on their own learning through a reflection at the end of the lesson and the homework problem.
7. Staying well: Students will be more confident in their skills by engaging in a task that draws from their knowledge of other subjects.
8. Working with others: Students will have the opportunity to work collaboratively with their peers, developing their mathematical and interpersonal skills.

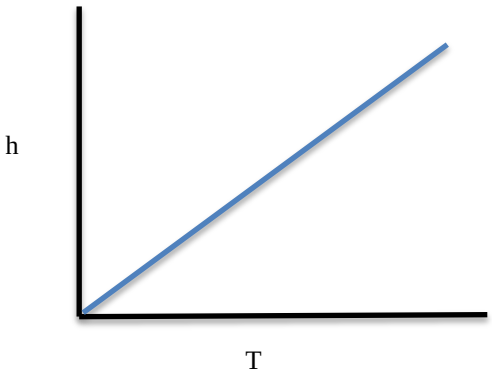
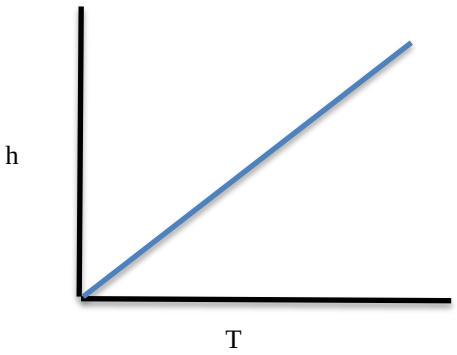
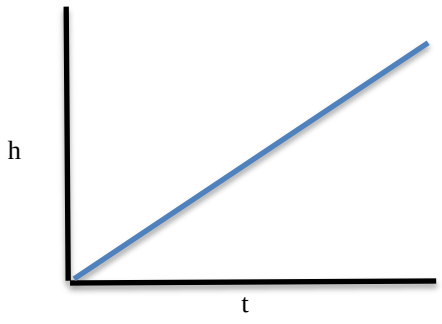
This lesson also meets the following JC statements of learning:

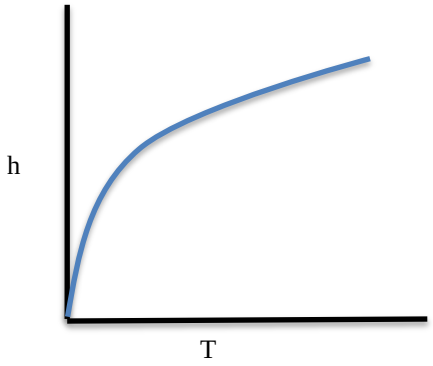
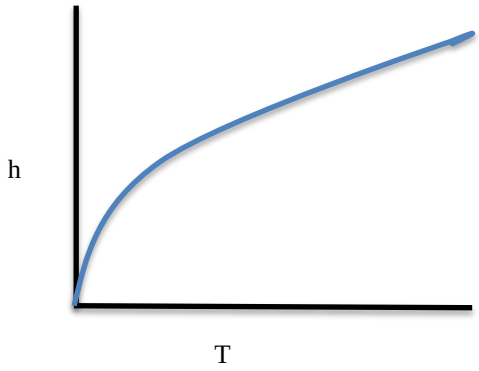
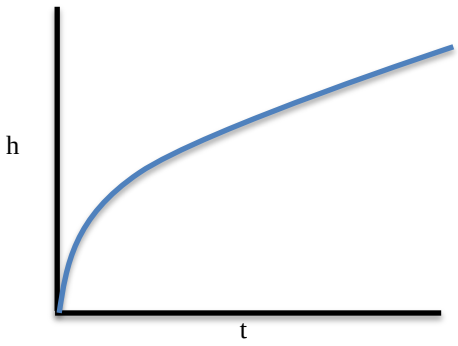
1. The students communicate effectively using a variety of means in a range of contexts
15. The students recognize the potential uses of mathematical knowledge, skills and

understanding in all areas of learning
16. The students describe, illustrate, interpret, predict and explain patterns and relationships
17. The students devise and evaluate strategies for investigating and solving problems using mathematical knowledge, reasoning and skills.

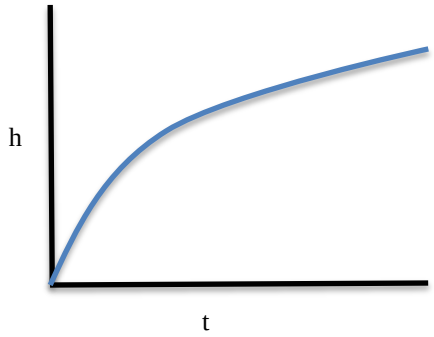
9. Flow of the Research Lesson:

Steps, Learning Activities Teacher's Questions and Expected Student Reactions	Teacher Support	Assessment
Introduction Today we are going to use our mathematical knowledge to solve a problem. We are going to try to solve the problem on our own and then we will come together as a class and use the knowledge to learn something new. To start with I am going to give you out a jigsaw to match. Match the graph to shape and write your answers on the show-me-boards.	Circulates to ensure that students are participating in the task	Assessing what the students learned in the previous lessons on the topic.
Posing the Task The pictures of three containers are on the board and on the demo table in the middle of the room. You are required to draw the graph of the flow of water into each container on the axes that are provided. (A3) Explain how you picked that graph for each particular container. What does 'the flow of water' mean? In turn you will be called to the central table to practice pouring water into the containers. Clarifying the problem: ➢ There are shapes on every desk ➢ Draw the graph of the water flowing into the container on the A3 sheet you have ➢ You do not need to put a scale on the axes. We are looking at proportion ➢ You have practice sheets as well Let's go over the problem. Do you know what the shapes are? ◆ "Beaker, Funnel, Conical flask" What are you graphing? ◆ "The flow of water into the container until its full" ◆ "How quick the water fills the containers" What has to go on the big sheets? ◆ "The final graph and how we got the answer" Do we need to use a scale? ◆ "No" Do we use pens or pencils? ◆ "Pencils"	Present the containers on the board (2D). The students have three A3 sheets for each of the students to present their final graphs. All students will also have smaller practice sheets with the axes printed on them. There will be a station in the middle of the classroom where the students can see how quickly the water fills the containers.	Do students understand the task? Do they understand the question? Are students eager to solve the problem? Do students understand that they are graphing the flow of water **into** the container?

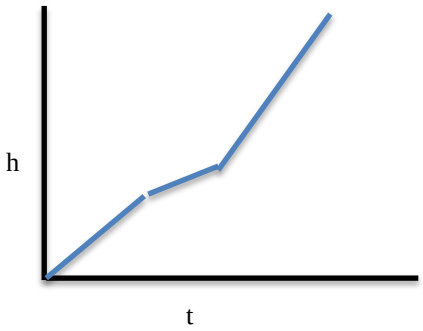
Student Individual Work Students response 1: (Beaker) the same as the starter question  	Teacher makes class rounds, checking that students are interacting and participating. Teacher looks for good examples of correct answers and of the approaches/methods students took/used. Teacher notes the order which students will come up to the board.	Do students understand the problem? Can students complete the problem?
Students response 2: (Beaker) Watching the water from the demo table  	If students are stuck or not participating, teacher will encourage them by asking appropriate questions. For example, "What did you notice in the starter activity?", "Did you see a pattern?", "What do you observe when you pour the water in?"	Can students make a connection between what they learned and encountered in previous lessons and in the starter activity?
Student response 3: (Beaker) the shape is uniform  	If students are drawing the incorrect graph for a container, teacher reminds students to remember what was happening when they were pouring the water into the containers. Teacher will not tutor students; however, will try to stimulate understanding.	

Student response 1: (Funnel) the flow of the water from the demo table  Student response 2: (Funnel) noticing a pattern from the starter problem  Student response 3: (funnel) noticing that the shape gets wider at the top.  	Teacher will encourage students to visit the demo table again, if necessary, to figure out what graph each container needs. Teacher can ask students "Can you find the graphs for each container using a method we have learned previously?".	

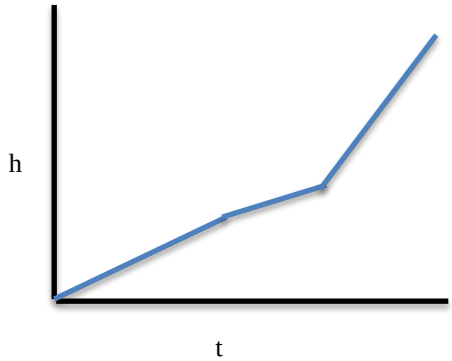
Student response 4: (funnel) the sides of the funnel get steeper towards the bottom of the shape.



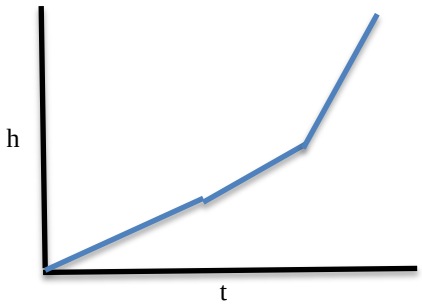
Student response 1: (Conical flask) the flow of the water of the demo room

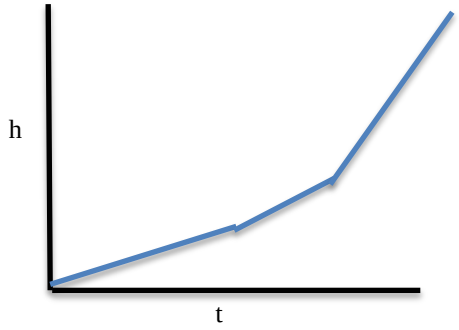
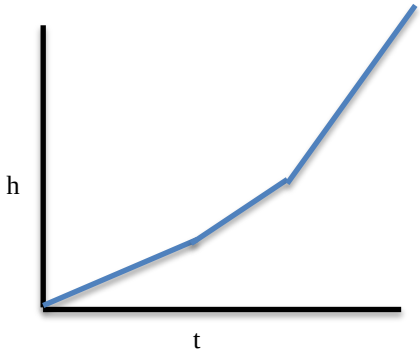


Student response 2: (Conical flask) noticing a pattern from the starter problem



Student response 3: (Conical flask) notice that the shape gets narrow at the top of the shape.



Student response 4: (Conical flask) Notices that the shape is steep at the top and gets gradually less steep towards the bottom  Student response 5: (Conical flask) notices that the shape changes slope.  		
Ceardaíocht /Comparing and Discussing The board is divided into three sections. A section for each container. Three different student approaches will be displayed under each container. Student Response 1, Beaker: "The same as the starter question" Student Response 2, Beaker: "Got the answer from watching the water from the demo table". Student Response 3, Beaker: "The shape is uniform/straight so this must be the graph for it filling up with water".	When group present their work on the board, the students' names will be included. Ask students to raise their hands if they think they drew their graphs for each container correctly. Ask the student to explain how they came up with their particular graph. Please raise your hand if you used this method or a different method.	Are students' defending their approaches/methods? Are they responding to other methods to draw the graphs? Did students see the patterns that would have been evident in the action part of the lesson? Can students understand quantitative graphs and make deductions from them?

Student Response 1, Funnel: "I could see the answer from pouring the water into the container at demo table". Student Response 2, Funnel: "I noticed that the shape gets wider at the top". Student Response 3, Funnel: "I see that the sides of the funnel get steeper towards the bottom of the shape". Student Response 1, Conical Flask: "I could see the flow of the water of the demo room". Student Response 2, Conical Flask: "I noticed the pattern from the starter activity". Students Response 3, Conical Flask: "I noticed that the shape changes slope and the water fills quicker".	When a student has the correct graph done for the relevant container, the teacher asks them how they came up with their graph. Ask any other students with the correct graph for the relevant container whether they used a different approach to get their graph.	Can students will make connections between the shape of the finished graph and the story behind it? Can students see how these quantitative graphs can be used in real-life?
Extending Students' Learning Real-life applications Teacher asks students: "In the real world, where would these graphs be useful?"	If students' struggle, teacher can give one example/try to stimulate students' thinking.	Can students see how these graphs can be used and are useful in real life situations?
Summing up & Reflection We learned that: • Graphs can be used to show… • Graphs like this can be used in real-life situations Students are asked to complete a plenary assessment task followed by a short reflection. The homework task will consolidate what the students have learned and explored in this lesson and in previous lessons in this unit. The short reflection will include the following points: Today I understood: Today I noticed: Today I learned from my group: Today I saw how mathematics can be used in the real-world:	The teacher after ensuring the board shows the containers and their correct graphs along with different methods will summarize what the lesson was about and what students have learned. This will provide students with a summary of the progress in their learning. The plenary will help consolidate what students have already learned and will "kick start" their homework task.	Have the students learned in this lesson? Were the students engaged throughout the lesson? Do the students' reflections represent the teacher's view of the lesson?

10. Board Plan

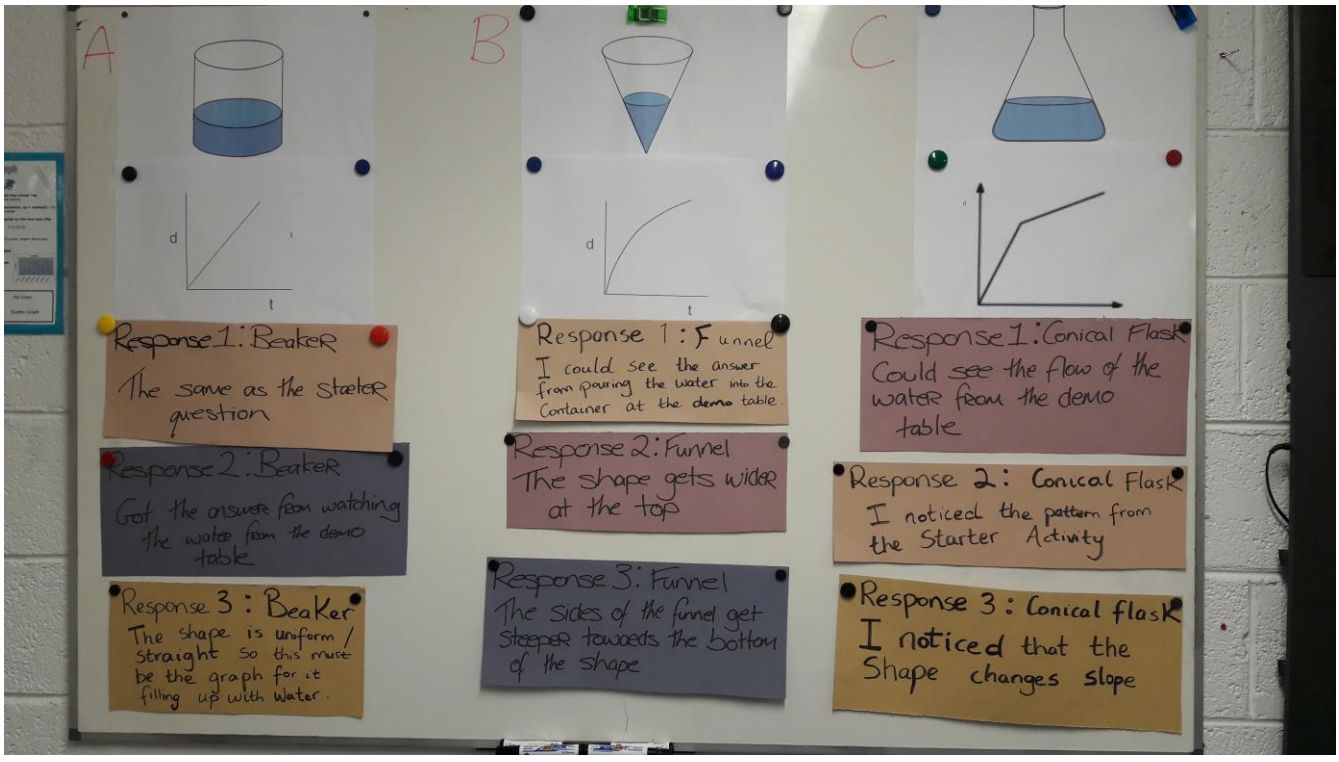
The Task

There are **3 containers** on the demo table in the middle of the room.

There is also a jug of water.

1. In your groups practise **filling** the containers with **water**.
2. Pay attention to the **flow of water** into the container.
3. When each group has practised this, they must **graph the flow of water** into each of the 3 containers on the A3 pages provided on your desks.

You have 20 minutes to complete your task ☺



11. Evaluation

Peer observation was carried out during the lesson. One teacher moved around the room photographing the students' work. Another teacher went around the groups observing students working in their groups and also noted students' interactions. The following questions were discussed during our post-lesson discussion:

- Were the students engaged during each task?
- Did the students learn and successfully complete their assigned tasks?
- What were the students' responses during Ceardaíocht?
- Were the reasons given by students for their answers what we anticipated?
- Was there evidence that the stated learning outcomes and aims of the lesson were achieved at the end of the lesson?
- Did students enjoy the lesson?

All participating teachers discussed their observations and thoughts on the students' learning during the lesson at the post-lesson evaluation discussion straight after the lesson.

12. Reflection

The flow of the lesson worked well for the most part. We found that having the starter problem on the table at the beginning of the lesson meant that the students' attention was divided. They had already begun to match the shapes and the graphs before we were ready for them. To avoid this in future we thought that putting the starter problem in an envelope would help keep the students' attention on the instructions for the lesson.

The students got involved very quickly and they seemed to have good discussions about the problem. The students worked well in groups and got involved in discussions about the way the graph should be drawn. They also had good reasoning for each of the graphs that they came up with and came to a consensus before drawing the final graphs.

Many of the groups worked on their own first and then together. One group took their practice sheets to the demonstration table to make rough graphs while watching the water flow. It was clear from the students' discussion and the graphs that they produced, that they understood why certain containers led to different graphs.

Students that were having a problem with the task were identified by the teacher. She encouraged the others in the groups to help explain the concept to that student. This ensured that all students actively participated in the lesson.

The teacher that taught the lesson felt that she was leading the students too much while trying to get the solutions which we had anticipated. The students rarely gave answers that had the demonstration table as a reason.

We found it interesting that the students were still confused about the flow of water that they were looking for even though the word 'into' was on the PowerPoint and was highlighted by the teacher.

There was some confusion between the students about the graph of the funnel. This was due to the fact that there was no stopper in the funnel. The students were told that they should imagine that there was a stopper but some of the students decided not to listen to this. It caused some confusion during the Ceardaíocht section. If we were to do this lesson again we would make sure that there was a stopper to avoid this problem.

During the lesson we discovered that we had underestimated the students. They got to, what we perceived to be the harder reasons, straight away. We found that it was harder to get them to give us the other answers.

The demonstration table worked well but having the groups waiting to go up to it slowed down the lesson as a whole. To improve this, we decided that one person from each group should go to the demonstration at a time for each container.

Overall, the lesson went well and we felt students enjoyed the lesson with many commenting that they preferred it to a 'theory' lesson and loved the interaction with the water. The lesson was well planned and carefully thought out and consequently the students achieved the lesson's learning outcomes:

- Students explored graphs of motion using real-life examples
- Students understood quantitative graphs and make deductions from them
- Students made connections between the shape of the finished graph and the story behind it
- Students were able to describe quantity and change in quantity on the graph
- Students will now be more confident in exploring graphs and using them to represent information in Maths, Science, Geography and other subjects.