## "The Cookie Crumbles!!"

2D to 3D Area and Volume Relationships.

$$
2017
$$

$2^{\text {nd }}$ year

Teacher: Ms G McGrath

Lesson plan developed by:<br>Grainne McGrath and Eddrina White

$2^{\text {nd }}$ Year \& Area to Volume Exploration

For the lesson on Area
and Volume.
At Presentation Secondary School, Ms McGrath's Class
Teacher: Ms White
Lesson plan developed by: Ms McGrath and Ms White

1. Title of the Lesson: Area to Volume Exploration. Moving from 2D to 3D shapes.
2. Brief description of the lesson: To help students understand that when moving from a 2 D to a 3D shape an extra variable will come into play.
3. Aims of the Lesson:

- I would like students to become independent learners.
- To become more creative when they are devising approaches and methods to solve problems.
- Appropriate application of key formulae
- Link the concept of prior knowledge to creating solutions for new problems.


## Long-range/thematic goals:

- I'd like my students to appreciate that mathematics can be used to solve real world problems
- I'd like to foster my students to become independent learners
- I'd like my students to experience meaningful mathematics i.e. that they see a need for what they are studying
- I'd like to build my students' enthusiasm for the subject by engaging them with stimulating activities


## Short term goals:

- I'd like my students to connect and review the concepts that we have studied already.
- For students to understand the relationship between the circumference of a circle, its diameter, radius and $\pi$.
- To establish the relationship between the area of circle and the volume of a cylinder.
- And finally to identify a formula that can be used to calculate the volume of a cylinder/


## 4. Learning Outcomes:

- Link the concept of area to volume.
- To establish the formula for calculating the area of a cylinder.
- Use the correct formula to calculate the volume of a cylinder
- To identify the relationship between the area of a circle and the volume of a cylinder.
- To identify that the by adding an extra dimension, namely, height, that this will transform our 2D circle into a 3D cylinder.


## 5. Background and Rationale

- The students have already met and used the area of a circle formula.
- Students have had difficulty with visualizing the relationship between area and volume.
- Students have found substituting the correct variables into the formula difficult.
- In this lesson, students will have to realize that when moving from 2-D to 3-D objects another variable needs to be considered.

Syllabus:

- Find the volume of cylinders.
- Modelling real world situations and solve a variety of problems (including multistep problems) involving volumes of cylinders.
- Perform calculations to solve problems involving the volume of cylinders.


## The thematic focus of this lesson is that:

- The students appreciate that mathematics can be used to solve real world problems to make the topic relevant to their real lives.
- The students appreciate that mathematics can be used to communicate thinking effectively so that they become more comfortable using mathematical language.
- The students become more creative when devising approaches and methods to solve problems so they can solve different types of problems they meet in the future. Transferable skills.


## 6. Research:

- Several Junior cert maths books.
- NCCA (2013) Junior Certificate Mathematics Syllabus: Foundation, ordinary and higher level for examination from 2016. Dublin.
- NCCA (2010). Common Introductory course for Junior Cycle mathematics. [online] Available at:http://www.ncca.ie/en/Curriculum_and _Assessment Postprimary_Education/Project_Maths/project_Maths_syllabuses/Revised_Common_Introd uctory_Course_Feb_10.pdf.[Accessed 01 April 16].
- Department of Education and Skills (2011). Literacy and numeracy for learning and life: The National Strategy to improve literacy and Numeracy Among Children and young people 2011-2020. Dublin :DES
- Jumior Cycle Course Committee, NCCA (2002). Mathematics: Junior Certificate Guidelines for teachers. Dublin:DES
- NCCA (2010). Common Introductory Course for junior Cycle Mathematics. [ONLINE]. Available at:http://www.ncca.ie/en/Curriculum_and-Assessment/Post-Primary-Education/Project_Maths/Project_Mathssyllabuses/Revised_Common_introductory_Course_feb_10.pdf.[Accessed 01 April 16]
- Cosgrove,J.,PPerkins, R., Shiel, G., G., Fish, R \& McGuinness, L (2012). Teaching and learning in projet Maths: Insights from Teachers who participated in PISA 2012 Dublin: Educational Research Centre.
- PMDT (2014). Teacher Handbook: First year (Draft) based on the 2016 syllabus. [online] http://www.projectmaths.ie/documents/handbooks/first year handbook 2015.pdf. Available at: [Accessed 01 April 16).


## 7. About the Unit and the Lesson

The content of this lesson relates to the Topic of Applied Measure in Strand 3, Numbers. This section revisits previous learning on number and number operations and develops a meaningful understanding of different number types, their use and properties. The student engages in applications of numeracy to solve real life problems and apply set theory as a strategy for solving problems in arithmetic.


Central to this lesson is the development of student's confidence and ability to problem solve. The student will be required to apply their knowledge and skills to solve problems in familiar and unfamiliar contexts. They will be required to analyse information presented and translate into mathematical form - devise, select and use appropriate mathematical formulae or techniques to process information and to draw relevant conclusions of this lesson.


## 8. Flow of the Unit:

| Lesson | 保 | \# of lesson periods |
| :---: | :---: | :---: |
| 1 | $\bullet$ Area and perimeter of 2D shapes | $1 \times 40 \mathrm{~min}$. |
| 2 | $\bullet$ Circle, circumference and $\pi$ | $1 \times 40 \mathrm{~min}$. |
| 3 | $\bullet$ Problem solving area, perimeter, circle and circumference | $1 \times 40 \mathrm{~min}$. |
| 4 | $\bullet$ Problem solving - moving from 2D to 3D shapes | $1 \times 40 \mathrm{~min}$. <br> Research Lesson |
| 5 | $\bullet$ Follow up lesson and extension | $1 \times 30 \mathrm{~min}$. |

## 9. Flow of the Lesson

## TASK 1

| Teaching Activity | Points of Consideration |
| :--- | :--- |
| Welcome the students and take roll call. <br> Students are divided into groups of 5. Each <br> group must identity a note taker and presenter. <br> A cookie is distributed to each student (do not <br> eat) along with white board and marker. | Tables will be set up prior to lesson to save time. <br> Arrange students into square group format. <br> Consideration will be given to each group to <br> ensure all student engagement. <br> Each group will reflect the mixed ability of the <br> classroom. |
| 1. Introduction (3 minutes) <br> Teacher will review ideas from the previous <br> lesson on the circle and area of a circle. | Prior knowledge will be put on the board. This <br> will include key terms such as diameter, radius <br> and $\pi$. Students will be instructed to take $\pi$ as <br> 3.14 throughout this lesson. |
| 2. Posing the Task (2 minutes) |  |
| - Prior knowledge on the circle will be |  |
| displayed on the board. | Students will consider each of the 3 options and <br> discuss it with group members. <br> Calculators will be needed at this stage. <br> Teachers will circulate the room, encouraging <br> and monitoring students who get into difficulty, <br> or students who finish early. |
| 3 images of cookive in boxes will be <br> displayed on the board, 1 large, 4 <br> medium, 9 small. |  |
| - The diameter of each cookie is given. |  |
| - The following question will be posed: |  |$\quad$| Which cookie will give the most cookie? |
| :--- |

Mata

| 3. Anticipated Student Responses (7 <br> minutes) | It is not expected that every student will calculate <br> the radius from diameter given but most students <br> should be able to complete task. |
| :--- | :--- |
| 2. Estimate are more than one- |  |
| 2.big cookie is best -Visualization | Teacher will note all student's methods and one <br> student from each group will come to the board <br> to display their findings. Weaker students will <br> be selected during this easier task. |
| 4. Comparing and Discussing <br> The teacher asks one student from each group <br> to come to the board to write out and explain <br> their answer. Teacher will offer praise for <br> students efforts. | Remember to get the students to sign their work <br> at the board. <br> Do students offer different ways to complete <br> task. <br> Students must be given the time to explain their <br> approach to the problem. |

TASK 2

| Teaching Activity | Points of Consideration |
| :--- | :--- |
| 1. Introduction (2 minutes) <br> Students will be asked to stack the cookies <br> given to them. They will be asked what shape <br> this stack forms. The teacher ask to them to <br> identify a method for working out the amount <br> of space this cylindrical shape occupies. | The success of this task requires that students <br> think independently, and link the concept of area <br> to space. The students will need to stack the <br> cookies to determine the volume. We require <br> that the students are able to identify the <br> information they need to establish the volume of <br> cylinder needed to contain their cookies. |
| Anticipated Student Responses (10 minutes) |  |
| -Students may suggest the <br> number of cookies to be <br> multiplied by Area of cookie. | Teachers will circulate the room, encouraging <br> and monitoring students who get into difficulty, <br> or students who finish early. |
| Students may connect the <br> stacked cookies to the shape to <br> the cylinder. | Students may link the stacked <br> cookies to the height of the <br> cylinder. |
| -Students may Identify the need <br> for a formula to be used. <br> - Students may derive a formula <br> incorporating height. |  |
| Students will derive the volume <br> of the cylinder. |  |


|  |  |
| :---: | :--- |
| 4. Comparing and Discussing <br> The teacher asks one student from each group <br> to come to the board to write out and explain <br> their answer. | Teacher will note all student's methods and one <br> student from each group will come to the board <br> to display their findings. <br> Remember to get the students to sign their work <br> at the board. <br> Do students offer different ways to complete <br> task. <br> Students must be given the time to explain their <br> approach to the problem. |
| 4. Summing Up | Students will be asked to note what happens <br> when you move from a 2D to a 3D shape? <br> Now make a note of what you have learned <br> today. <br> Assessment: What would happen if the area of <br> the cookie doubled? |

## 10. Evaluation

- There will be one teacher and one observer. The class will be split into 5 groups with five students in each group.
- Both the teacher and observer will circulate the room during Task 1 and 2 and will note students behaviours and engagement in problem solving.
- The observer will photograph students work.
- A formal meeting will take place immediately after the lesson to discuss.


## 11. Board Plan




Mata



## Post-lesson reflection

The prior knowledge supported the success of the first task. All students quickly recognised the need to use the formula of the area of the circle to choose the most cookie. The students were slow to move beyond use of calculation to solve. As part of ceardaiocht, one student mentioned the use of estimation as a means of selecting the most cookie. This opened a discussion on the use and importannce of estimation in solving problems. Certainly task 1 showed a dependency on the use of a defined formula to solve the task given. This was supported by the fact they had prior knowledge of a formula. Task 2 proved more challenging for the students. It required more investigation and discussion which was certainly evident. The students played more freely with the task. They explored the building of the cookie stack and measured the stack enthusiastically. Students grasped the need to measure the height and most students used the formula to find area of the cookie. However, only one group (group 3) successfully formulated the volume of cookie stack. On reflection, I believe the other teams were very close to completing the task but showed an almost fear to be wrong. This is a cultural trait within the class group. Moving forward, more of this type of activity will encourage students to 'try' and not be afraid to be wrong. I reassured the students during ceardiocht that all contributions were building to the success of the task. The students enjoyed the board work and delivered their solutions were clearly. I believe the student successfully built a formula without really realising this. In this way students achieved their learning goals. The students moved successfully from 2D shapes to 3D


Appendix




## Large cookies have a 6 inch diameter.

# Medium cookies each have a diameter of 3 inches. 

## Small cookies each have a diameter of 2 inches.

The bakery will box the cookies so that you can get the largest one in one box, four medium cookies in one box, or 9 small cookies in one box so they look like this:

$$
\begin{aligned}
& \text { Your team's } \\
& \text { mission is to } \\
& \text { determine } \\
& \text { which type of } \\
& \text { cookie will } \\
& \text { give the class } \\
& \text { the most } \\
& \text { cookie! }
\end{aligned}
$$

PRIOR KNOWLEDGE


CYLINDER

VISUALISATION

## ESTIMATION

## TRIAL



FORMULA

# CALCULATION 

