THOMPSON RIVERS UNIVERSITY | Education & Social Work

Bachelor of Education (Elementary) & Bachelor of Education (Secondary) STEM Lesson Plan

Lesson Title: Derivatives through Trigonometric Functions **Lesson #** 1 **Date:** Thursday, January 7th 2021

Name: Julia Sonnleitner **Subject:** Calculus **Grade(s):** 12

Rationale:

This lesson introduces students to the idea of performing derivatives on trigonometric functions. Learning how to derive functions is a foundational skill student will need to not only continue their learning further in calculus courses, but also fundamental in a sciences or business environment. Trigonometric functions can be applied to a wide range of real life scenarios and learning how to derive them helps students understand the how different functions change instantaneously.

Core Competencies:

Communication	Thinking	Personal & Social
Connecting and engaging with others Working collectively. They are also informally present and communicate their learning to the class. Students communicate to build and sustain positive relationships with their peers.	Students apply critical and reflective thinking to acquire and interpret information. They are encouraged to think creatively and with curiosity when approaching a problem.	

Big Ideas (Understand)

- Differential calculus develops the concept of instantaneous rate of change.
- The concept of a limit is foundational to calculus.

Learning Standards

(DO)	(KNOW)
Learning Standards - Curricular Competencies	**Learning Standards - Content**

• Think creatively and with curiosity and wonder when exploring problems
• Solve problems with persistence and a positive disposition
• Use mathematical vocabulary and language to contribute to discussions in the classroom
• Take risks when offering ideas in classroom discourse
• Reflect on mathematical thinking
	• Differentiation
	  ○ Definition of a derivative
	  ○ Transcendental functions: trigonometric

Instructional Objectives & Assessment

Instructional Objectives (students will be able to…)	Assessment
• Explain to their peers that the derivative of sin(x) is cos(x) in multiple forms • Prove and evaluate complex limits using the definition of a derivative • Communicate their ideas with their peers • Apply other big ideas and concepts in calculus to trigonometric fuctions.	• Assigned Homework (Summative) • Interactive group questions (Summative)

Prerequisite Concepts and Skills:

Students will have already learned and reviewed PreCalc 11 trigonometric functions.

Indigenous Connections/ First Peoples Principles of Learning:

I was unable to make a meaningful connection to the FPPL

Universal Design for Learning (UDL):

Students will be given both individual and group work This lesson plan supports learners with multiple intelligences: **Interpersonal** – Reflecting on their own knowledge and reflecting on previous skills **Existential** – Students will be able to explore two of the big ideas in Calculus 12. They will also be supported by real world examples of math models. **Bodily-Kinetic** – Students will have to stand up and move around to complete the lesson **Visual Spatial** – Students will be given many visual examples of how the derivative of sinx is cosx **Interpersonal** – Students will be asked to work in groups to solve problem **Verbal-Linguistic** – Students will be encouraged to communicate their learning verbally. They will also have to read the questions in the back of a textbook **Logical Mathematical** – This lesson will heavily support students with a logical mathematical brain

Differentiate Instruction (DI):

None of the students require DI

Materials and Resources

Computer, extra whiteboard markers, speaker and a projector

Lesson Activities:

Teacher Activities	Student Activities	Time
Introduction (anticipatory set – "HOOK"): Tell students about cool news in math. https://phys.org/news/2020-10-interactions-larger-social-groups-contagion.html I am first going to review trig functions. I am going to write derivative on the board and ask students to verbally reflect on their learning. I will try to prompt them to see if they remember the mathematical definition of a derivative. If not I will write it on the board ($\frac{dy}{dx} = \lim_{h\to 0}(\frac{f(x-h)-f(x)}{h}$) Ask them which functions they have derived so far? (ln(x), e^x, x, n, n^x) Ask them if there are any functions they haven't seen? Help them if needed, but all the trig functions,	Students listen to introduction and contribute to reviewing trig functions and what derivative is. They might even know what the definition of a derivative is. They are expected to participate in lecture and answer questions.	15 min
Body: Say that I am going to prove that d/dx sin(x) = cos(x). Start by using the definition of derivative to solve sin(0) and cos(0). Start will sin(0) and demonstrate.	Student listen to lecture, take notes and answer/ask questions.	45 min

Show them how to use desmos (https://www.desmos.com/calculator) to answer the question. Ask students to participate in solving cos(0). Use wolfram Alpha to solve cos(0) (https://www.wolframalpha.com/) Write both solutions in an important area of the board with a different coloured whiteboard marker. Solve the derivative of sin(x). Show visualization of this video proof. Using a rock climber on a sin and cos graph and compare the two. Show them a visual representation of it (gif- https://www.gizmocrazed.com/2014/08/these-gifs-will-help-you-understand-math-concepts-better-than-your-teacher-ever-did/) Ask them to predict the derivative of cos(x). Get them to stand up and try to prove it on the white board in groups of 4. Provide remind them that identity 4 in there textbook on page 549 ($\cos(2u) = \cos^2(x)-\sin^2(x)$). Go between groups giving them clues when needed. Discuss the result and any issues with the class. Introduce them to the derivatives of the other trig identities. (tanx, cotx, secx, cscx) Prove that d/dx sec is equal to tanxsecx and d/dxcot = $-\csc^2 x$ Remind them of the quotient rule. Divide them into groups of two and get them to try three different problem I placed on each whiteboard. (One will be a chemistry problem - ***) We will then rotate groups and the second group will assess the first groups work. We will then go over it as a class and they will be given time to write all three problems down.	Students will be asked to predict the derivative of cosx. They will be asked to separate into groups and try to solve it on the white board. Students will be given the trig identities. Either in their textbook or their notes.The results will be discussed with the whole class. They will take note of the other trig identities. They will also follow another proof example. They will then be asked to go back the white boards and solve different questions. The groups will rotate and they will evaluate whether they agree or not with the other groups answers. We will go over the solutions as a class.	
Closure: Students will complete Homework questions from their textbook on page 560 #7,9,13,17,19,23,29,33,34,41,44 #1 and 2 These will be due at the end of class	Students will work on homework questions until the break.	15 min

Organizational Strategies:

On the side of the whiteboard I will have the important equations displayed. Students will be given breaks in between lectures to work and apply their knowledge. I will let some students work through challenges. This depends on how the student learns best some students may need an answer presented in front of them immediately to proceed.

Proactive, Positive Classroom Learning Environment Strategies:

I plan on encouraging a positive learning environment by setting clear and consistent expectations, modeling positive and enthusiastic behaviour and by using lot of positive affirmations while speaking to and evaluating students.

Extensions:

The material covered in this lesson is going to be on their term test on Friday. A great extension to this would be to organize a physics or engineering guest speaker to discuss how calculus and trigonometry is an integral part of their career.

Reflections (if necessary, continue on separate sheet):
