

Lesson Plan Using Inductive Instructional Models

A. Description of Inductive Instructional Model	This lesson will be presented using an inductive instruction model of integration. Students will be given examples of famous circles and asked to measure the distance across the circle, using a string to measure the distance around the circle. Students will be asked to compare the differences and propose a theory about their relationship. The teacher will then lead a controlled discussion to help the students develop a theory to explain the relationship between a circle's perimeter and diameter. The teacher will introduce them to pi once they have concluded that the circumference is about 3 times larger than the diameter. This is an integrative model of instruction since the teacher is providing the students with examples to measure the diameters and circumferences of various circles while leading a discussion to help them understand the relationship and how pi is needed to create a formula for explaining said relationship. They should gain a deeper understanding of pi by asking the students to develop a theory rather than just telling them to use a formula. Throughout this lesson, the teacher's role is to guide the students through the process and lead the discussion of the relationship for the students. Once the students have a solid hypothesis, the teacher will introduce pi.
B. Introduction	Teacher: Robin Murphy Subject: Mathematics Grade: 7 Title of Lesson: Exploring Diameter and Circumference of Circles Time Needed: 45 minutes Unit Topic: Geometry Model of Instruction: Integration (Inductive Reasoning)
C. Rationale	This lesson will visually demonstrate the meanings and differences of a circle's diameter and circumference. This should give them a deeper understanding of the measures rather than just telling them the definition. Students will form their conclusions or theories about the relationship between diameter and circumference before being introduced to pi. This should also help them understand why pi is used and what it represents. The lesson progresses logically with teacher-led discussions that should allow an equitable experience for all student backgrounds. In addition, students will be placed in small groups organized by the teacher. Student's backgrounds will be considered when planning groups. Groups will be arranged as diversely as the class allows, and students who generally perform well in class will be grouped with students who need extra help.
D. Learning prerequisites	- Students should be able to use a ruler for measurement. - Students should be able to fill out a simple chart.
E. Lesson Goals	- Students will be able to measure the diameter and circumference of a circle using a ruler and string. - Students will be able to compare a circle's diameter and circumference. - Students will be able to demonstrate the relationship between a circle's diameter and circumference using pi.
F. State (or NCTM) Objectives	NCTM- C.3.7: Geometric constructions, axiomatic reasoning, and making and proving conjectures about geometric shapes and relations
G. Student-Oriented Objectives and Each Type of Objective	- I am learning about how to measure a circle's diameter and circumference. (Psychomotor) - I am learning about how to compare the perimeter and circumference of a circle. (Affective) - I am learning about how to explain the concept behind pi. (Cognitive)

H. Organizing or Essential Questions	- o Is the diameter or circumference of a circle longer? - o How much larger is the circumference of a circle than the diameter? - o What is the value of pi?
I. Writing Element	After students have completed their table, they must write a statement about the relationship between the diameter and circumference of a circle, using an example to justify their reasoning. The writing must show that students understand the relationship and know the value of the difference between the diameter and circumference. Students will then post the statement to their class's blog.
J. Technology Element	The instructor will use the Internet and their computer to search for pictures of famous circles, such as Columbus Circle in New York, Stonehenge, the moon, and others, that can be printed out and given to the students. The students will use their iPads or MacBooks to write their statements about the relationship between the diameter and circumference of a circle in their class blog.
K. Materials and Resources	Materials Needed Per Group: - o String - o Ruler - o Paper - o Printouts of famous circles - o MacBook or iPad
L. Inductive Model Steps for Lesson Plan	Step 1: Planning for the integrative model Step 2: Describe, compare, and search for patterns in a data set Step 3: Explain the identified similarities and differences Step 4: Hypothesize what would happen under different conditions Step 5: Make broad generalizations about the topic and the discussion
L1. Engaging Students Activity	Students will be instructed to line up in one corner of the room as they enter class. Then, they will be instructed to walk across the room. Next, the students will be told to circle around the room. The students will comment on which walk was longer.
L2. Lesson Development	Step 1- Planning: The students will learn about the diameter and circumference of a circle. Rather than simply giving them the formula and telling them this is how it is done, they will be led in an integrative method to discover the diameter and perimeter of a circle for themselves and formulate a ratio to calculate them using pi. Before class, print out copies of pictures of famous circles such as Columbus Circle in New York, Stonehenge, the moon, Place Charles de Gaulle in Paris, and the circle around Walt Disney and Mikey Mouse in Disneyland. Assign students into groups, considering which may need special placement. Assign roles to the groups if needed. Each group will be provided printouts of five famous circles. Provide each group with a string, ruler, and paper. Step 2- Design, compare, and search for patterns in a set: Begin by demonstrating what students should do first. Take one of the photos and measure the distance across the circle using a ruler. Explain that this is like walking across the circle of the room as they did at the beginning of class. Tell the students that this is called the diameter of a circle. Next, take the string and wrap it around the image of the circle and, mark the distance, measure the distance using the ruler. Explain this is like walking around the circle or the room as they did at the beginning of class. Tell them that this measurement is called the circumference of the circle. Create a simple table and write down the name of the circle. It is measured across and measured around. (A pre-made blank chart with the materials could also be given out.) Ask the students if they noticed anything about the measurements or from walking around the room. Students should point out that it is longer to go around the circle than straight across. Some may notice that the difference is about three times greater going around than across. Instruct the students to measure the distance across and the distance around each remaining circle and complete their tables. Step 3- Explain the identified similarities and differences Once the students are finished measuring each circle, call on them to give their measurements and use their numbers to complete your chart (if more than one answer is given for any measurement, reach a consensus before moving on). Again, ask the students to examine the measurements and point out what they notice. Some may notice that both

	numbers increase as the circle gets larger and that the circumference is always about three times larger than the diameter. Step 4- Hypothesis of what would happen under different conditions: Have the students add a new column to their table. This column should be the ratio of the circumference to the diameter. Have the students find the ratio and complete their charts. Most students should find that the ratio is about three or slightly over three. Based on the observations of the students, they should hypothesize that the circumference of any circle is about three times larger than its diameter. Instruct the students to use their iPad or MacBook and write a statement about the relationship between the diameter and circumference of a circle in their class blog. Step 5- Make broad generalizations about the topic and discuss Once students have hypothesized that the circumference is about or a little over three times the size of the diameter, explain to the students that it is possible to find the circumference of any circle by only knowing the diameter. Ask the students if the diameter of a circle was ten and how large the circumference would be. Provide a couple more examples for the students to answer to be sure they are seeing the relationship. Students should now be ready to discover pi. Explain to the students that pi, written mathematically as π, is a special number that has no ending, but it is commonly abbreviated as 3.14, and that it is exactly π times longer to go around a circle than it is to go across a circle. In other words, to find the circumference of a circle (c), you must multiply π times the diameter (d), or $c=\pi d$. The students can practice this new number by returning to their circles and using the measurement of the diameter multiplied by π to find the circumference.
L3. Guided and/or Independent Practice	As the students are working to calculate the circumference of their circles using π times the diameter, walk around and observe if any students need help and how well the students are understanding the new information. If any students are struggling offer additional support. Once students understand the new information. Provide them with a new problem but give them the diameter of a circle and ask them to find its circumference. Again, observe students to assess how well they are absorbing the information and if they are completing the problems correctly.
L4. Lesson Closure	Guide the students in a brief overview of what they learned in class today. Ask a student to tell the class something they learned today. Ask another student to name something else. Guide the discussion until the student has named the diameter and circumference and the circle, pi, and the formula.
L5. Homework Outside the Classroom	For homework, students should draw five different size circles. The students should measure the diameter and use it to calculate the circumference.
L6. Extension	Each student should find three examples of circles in the classroom. The student should measure the circle's diameter and then calculate its circumference. Students should take pictures of their circles, if possible, if not, they must describe what the circle is.
M. Formative Assessments	Assigning roles in the groups when measuring their photos will help the students stay on task and focus on the lesson. By leading the discussions, it is possible to select different students to speak up to ensure they are paying attention and understanding the topic. Classroom observations help ensure students are staying on task and focused. They are also an excellent way to see the students' progress or if they are struggling. Homework can also be used to track students' progress and understanding of the material.
N. Supporting Student Learning	Multiple intelligences are being addressed throughout the lesson to address the different learning styles in the classroom. Visual-spatial intelligences should enjoy the engaging student activity at the beginning of the class. The extension assignment should appeal to the naturalist intelligences. Mathematical-logical intelligence should enjoy working out the relationship pattern between the diameter and circumference of a circle. Much of the lesson revolves around images and drawings which should help visual-spatial intelligences. The group work should appeal to interpersonal intelligence. There is a new vocabulary for verbal-linguistic intelligences. Students of all cultures should be able to participate and feel accepted by maintaining a respectful classroom. The material is basic and should not cause any cultural issues to occur. When assigning groups, they should be as diverse as the class allows. Encourage students to form a positive math identity by encouraging them to ask questions, let them know mistakes are okay, we all make mistakes sometimes, praise effort, and maintain a positive attitude throughout the class.

O. Reflection for modification

Recording oneself can be a very effective tool for self-evaluation. Rather than trying to focus on things you would like to change for next time, you can record yourself and watch it later when you have time to evaluate your teaching methods. It is possible to see yourself from a different perspective. You may even notice something you said incorrectly or did wrong that you may not have otherwise noticed. It is also possible to pause and rewind the video as needed if you need to rewatch it for clarity or take notes. If the camera is set up in a location to see the students, it may also be possible to tell if the students seem to be engaged and learning or what changes you may need to make to make your lesson more engaging for the students.

Lesson plan modified from:

Exploring circumference with famous circles. Byrdseed. (2022, January 17). <https://www.byrdseed.com/exploring-circumference-with-famous-circles/>