LESSON PLAN by Adam Pyle

Lesson: Circles   **Length:** 70 minutes

Age/Grade Intended: Algebra II

Academic Standard(s):
Standard 4 Conic Sections
A2.4.1 Write the equations of conic sections (circle, ellipse, parabola, and hyperbola).
A2.4.2 Graph conic sections.

Performance Objectives:
Given a center and a radius, the students will write eight equations of circles with 100% accuracy.

Given the equation of a circle, the students will graph three circles with 100% accuracy.

Given a center and a radius, the students will graph a circle with 100% accuracy.

Assessment:
At the end of the period, the teacher will put three problems on the overhead for the students to complete before the end of the period. One will ask the students to find the center and radius of a circle and graph it given the equation. Another will ask the students to write an equation for a circle given the center and radius. The last will ask the students to write an equation and graph a circle given the center and radius. In addition to this assessment, the students will have a homework assignment to be collected the next day with a variety of similar and more challenging problems.

Advanced Preparation by the Teacher:
The teacher will need to get a copy of Edwin Abbott's <u>Flatland</u>. For the circle construction activity, the teacher will need to get enough scrap paper and rulers for the entire class. The teacher also needs to put careful thought into the outline to be provided to the learning disabled students. He or she should be sure to leave out words the students should see in their own hand, but minimize the writing they have to do so that they can pay appropriate attention to the teacher.

Procedure:
      Introduction/Motivation
After five minutes reviewing parabolas, read aloud the first ten pages of <u>Flatland</u> by Edwin Abbott. This novel concerns characters that live in a two-dimensional plane and later encounter space. Follow the reading with the following questions:
- In Abbott's work the women are all straight lines, the middle class members are equilateral triangles, and the nobility are hexagons. Additionally the circles represent the

priestly class. Pick one to consider. Why do you think Abbott made these associations? Think about the properties of these geometric figures. (*Evaluation*)
- What do the associations tell us about the class structure of Flatland? (*Analysis*)
- The inhabitants of Flatland can only see straight lines. What if this was the case for you? How would you adjust? (*Evaluation*)

After the brief discussion, draw a circle on the board. Then ask:
- What is this? (*Comprehension*)
- What makes it a circle? (*Hint*: Think back to your geometry class.) (*Comprehension*)

Tell the students that the class is going to look at circles, another conic section, from an algebraic perspective.

Step-by-Step Plan:
1. Distribute a piece of scrap paper and a ruler to each student. The students will be told to pick a spot anywhere on the paper. Tell them to imagine that their point lies on the coordinate plane and should be labeled with the coordinates (h, k).
2. The students should then be instructed to lay the ruler on the scrap piece of paper so that one side of the ruler passes like a line through their point. A line will then be drawn on the paper using the other side of the ruler as the straightedge.
3. The students should be told to repeat this procedure many times and make several lines all the way around their point.
4. Ask:
   a. What conic section do we see forming? (*Comprehension*)
   b. Why has this procedure created a circle? (*Analysis*)
5. Tell the students to make the circle more definite by darkening its perimeter. The students should then choose any point of the perimeter and label it (x, y).
6. Ask:
   a. What do we know about circles? (*Comprehension*)
   b. How can we use information about the radius and the distance formula to find an equation for the circle? (*Analysis*)
7. Follow with a brief lecture on circles. An outline of the lecture is provided.
8. Instruct the students to get out their vocabulary organizers and fill in the appropriate columns concerning circles. Remind the students to find circles in real life from their magazines.
9. After the vocabulary charts have been completed for circles, place three problems on the board. A description of the problems can be found in the assessment section. Ask the students to complete these and hand in before the end of the period. (*Application*)

Closure:
After ten minutes of filling out the vocabulary charts and working on the in-class assessment, again draw a circle on the board. Ask:
- What do we now know about this circle? (*Hint*: Think about both your geometry and algebra classes now). In other words, what can we say about this circle in algebraic terms? (*Comprehension*)

Students should use the remainder of the time to work on the assignment.

Gardner's Theory of Multiple Intelligences:
Verbal/Linguistic: Listening to <u>Flatland</u>, describing the circle in their own words on the vocabulary charts, listening to the lecture
Visual/Spatial: Finding magazine pictures of circles, using the center and the ruler to construct a circle
Logical/Mathematical: Writing equations for circles, graphing circles
Intrapersonal: Finding their own words to remember textbook definitions in the construction of their vocabulary charts

Adaptations/Enrichment:
Students with learning disabilities will be placed near the teacher's place of instruction. This will allow the teacher to make frequent eye contact and check for understanding. The chart for vocabulary will assist such students in the organization of their notes and provide a quick reference sheet while the students work on their homework. The teacher will also provide learning disabled students with a fill-in-the-blank guide for note taking during the lecture. This will allow the students to concentrate on the content and the teacher rather than their own ability to get everything the teacher says written down.

Self-Reflection:
These questions will guide my self-reflection after the lesson has been taught:
- Did the circle construction (using straight lines) contribute to students' understanding of the academic standards (writing equations for and graphing circles)?
- If the read aloud, direct instruction, and circle activity take more time than I intend, will students feel rushed on the in-class assessment and therefore perform at levels below those established by the learning objectives?
- <u>Flatland</u> is rather abstract. Are students annoyed by its unusual sentence structure and word choice? Does this annoyance contribute to a checking out situation?