Lesson: Ellipses (Part 2)  

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 the endpoints of the major axis and the endpoints of the minor axis, the students will write three equations of ellipses with 100% accuracy.  

Given the endpoints of one of the axes and the coordinates of the foci, the students will write five equations for ellipses with 80% accuracy.  

Given an equation in standard form, the students will graph two ellipses with 100% accuracy.  

Given an equation not in standard form, the students graph four ellipses with 75% accuracy.  

Assessment:  
The students will submit the writing activity that takes place at the beginning of the period. They will be given a checklist on the board for particulars to include in this writing. One part asks the students to list something “negative” about the conic sections that they have not chosen. They will likely list things for which they still have questions or struggles. The teacher should these as a clue for what to reinforce. The students will also submit their worksheet from the group circle activity. The teacher can use this to see both how the students are thinking about ellipses and how they manipulate given information to write equations for and graph ellipses.  

Advanced Preparation by the Teacher:  
The teacher will need to prepare the checklist for the writing activity and the worksheet for the grouping circle activity. These worksheets will need to be numbered 1 or 2.  

Procedure:  
Introduction/Motivation:  
The students will begin the period with a writing activity. The following should be written on the board:
R = Whichever of the three conic sections we’ve discussed (parabola, circle, ellipse)  
A = The human race  
F = A campaign speech  
T = Why you should vote for me in the next “Best Conic Section” election  

Explain to the students that R is for the role the students must take, A is the audience to which the students are writing, F is the format in which the work should be written, and T is the topic of the writing. Tell the students this should be done on a piece of paper that they can submit. Tell the students to include two “positive” traits of the chosen conic section and one “negative” characteristic of the others (the ones they did not choose).

Step-by-Step Plan:
1. After the students have finished and submitted their writings, begin with some questions pertaining to the previous day’s material:
   a. As the foci of an ellipse get closer together, what happens to the shape of the ellipse? (Comprehension)  
   b. What can we say about any two points lying on the same ellipse? (Comprehension)  
   c. In terms of axes of symmetry, how is an ellipse different than a circle? (Analysis)  
   d. Is a circle actually an ellipse? (Analysis)
2. At this point continue the class discussion of ellipses. Be sure to cover axes of symmetry (major and minor axis), how an equation depends upon the direction of the major axis, and the relationship between the distances from the center of the ellipse to each of the foci, major axis endpoint, and minor axis endpoint. An outline of the lecture, with questions, is provided.
3. After the lecture is complete, distribute the worksheet to each student. Each worksheet will be labeled with a 1 or a 2. (This pile should be jumbled.)
4. Tell the 1’s to arrange their desks in a circular pattern in the middle of the room (facing the walls); have the 2’s arrange their desks in a circular pattern such that each desk faces an inner desk. If there are an odd number of students, participate by sitting at a desk. Otherwise, monitor and assist where help is needed.
5. Explain the procedures of the activity to the students (Analysis and Application):
   a. Work on a problem with the first person with whom you are teamed. Next to the problem, write what you are thinking. Use questions such as these to guide you:
      i. What information do I need to solve the problem?  
      ii. What am I given?  
      iii. How can I use this given information?  
   b. Spend two to three minutes gathering your thoughts and two to three minutes solving the problem.  
   c. On the teacher’s cue, the inner circle should rotate one spot right. Compare both thought processes and solutions with this new partner. Add any new information you may have gained from this meeting.  
   d. On the teacher’s cue, the outer circle should move one spot left. Begin problem 2 with this partner.  
   e. A similar pattern will occur until the worksheet is complete.
f. Submit the worksheet when it is finished or when the teacher ends the activity.

6. Instruct the students to get out their vocabulary charts and begin to fill in the appropriate columns concerning ellipses. Remind the students to find ellipses occurring in real life from their magazines.

**Closure:**
After the students have mostly completed their vocabulary charts for ellipses, ask them the following question:
- Can you say there is anything in common about the three conic sections we have looked at thus far (parabolas, circles, ellipses)? (*Analysis*)

Tell the students that the conic sections we have studied are all one continuous branch. Things will get a little crazy when the next, more mysterious conic section is introduced.

**Gardner’s Theory of Multiple Intelligences:**
*Logical-Mathematical:* Writing equations for ellipses, graphing ellipses  
*Interpersonal:* Using the grouping circle to collaborate with many different classmates about both thinking processes and solving problems concerning ellipses  
*Intrapersonal:* Using their vocabulary charts to describe ellipses in their own words  
*Verbal-Linguistic:* Writing the campaign speech, describing their approaches to problems in words during the grouping circle activity

**Adaptations/Enrichment:**
In the beginning this lesson could be challenging for students with emotional disturbances. The lecture style could actually encourage misbehavior. The teacher should give students some breaks to stand up and stretch or even get a drink of water. Also the teacher should be sure to remain especially enthusiastic during the lecture. Giving the emotionally disturbed student tasks could bolster their sense of responsibility and encourage future cooperation. Suitable tasks for a student in this lesson could include mixing up the labeled worksheets prior to their distribution for the grouping circle activity. If the teacher must participate in this activity, pair up with the emotionally disturbed student. This will allow the student to be acclimated to the circumstances of the activity with someone whom the student may trust. (Of course this trust depends on teacher-student interactions prior to this lesson.) The teacher should use this brief meeting to assess the situation. Perhaps the student would work better alone than in a face-to-face with another classmate. During the meeting the teacher should find things for which the student can be complemented. These should be specific encouragements and not merely fluff statements.

**Self-Reflection:**
These questions will guide my reflection after teaching the lesson:
- Do the multiple perspectives gained from participating in the grouping circle activity contribute to students’ understandings of ellipse equations and graphs?  
- Did the students take the writing to learn activity seriously? They may not be accustomed to writing in math classes and therefore may brush this aside as a light activity for which their full concentration is not needed.