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Grade Level/Subject: Algebra II or higher

Topic: Patty Paper Conics

Objectives (P.A.S.S.): This best comes as a High School Process Standard 2: Communications; 3. Analyze mathematical definitions and discover generalizations through investigations, but also touches on Algebra II Standard II.6--Identify, (graph, and write the equations of) conic sections.

Introduction: This activity comes from NCTM 1987 Yearbook p. 165 "Wax Paper by Roselyn Teukolsky. Students read and learn definitions of various mathematical ideas but often have no real understanding of what they mean. This activity helps make sense of the definitions for parabola, ellipse and hyperbola and is a nice break from the pencil and paper lessons so common in higher math.

Materials. 3 pieces of waxed paper, at least 6 by 6 inches per student (or use patty paper), compass, ruler, and pen or pencil that will write on the paper.

Instructional process: Students are given the papers with the following instructions. On the first piece of paper they need to draw a straight line with the ruler and make a point not on the line. They should then fold this point onto the line at different points--as many as possible in about five minutes. Each fold is etched into the wax paper as a visible line, and soon a picture emerges. On the second piece of paper they should make a circle about 4 inches in diameter and take a point, other than the center, in the interior of the circle. This point should be folded onto the circle at as many different points as possible in the time allowed. On the third paper they can make a circle and take a point outside it. As before, the point is folded onto the circle.

After the folding is done, then a discussion should take place relating what they started with and the definitions of each conic and how they are related to the activity.

A parabola is a set of all points equidistant from a fixed line, called the directrix, and a fixed point not on the line, called a focus.

An ellipse is the set of all points P in the plane such that the sum of the distances from P to two fixed points is a given constant.

A hyperbola is the set of all points P in the plane such that the difference between the distances from P to two fixed points is a given constant.

It is especially interesting to hear their input as to why the point inside the circle relates to the constant sum of the distances and the point outside the circle relates to the constant difference.

Closure: This is best done by having them write the definitions in their vocabulary notebooks and/or write a reflection on what they have done and what was discovered.

Assessment: An observation with any grading based on participation in both the folding and the discussion or reflection is the simplest way to assess this activity.

Modifications/Accommodations: Usually none is needed, but if there were physical limitations on being able to fold, such as my student with one arm currently unavailable due to a broken collar bone, he or she could act as coach or assistant during the folding and then still participate fully in the discussion based on his/her observation of the other students work.

Reflection: This is a good activity for a break in routine and seems to leave a more memorable imprint of the definitions of shapes that have hard to understand definitions otherwise. It seems to work better as an introduction to conics than as an activity later in the unit although I have used it both ways and the students enjoy it at either time.