From Math Circles to Science Fairs

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- Serve OKC Metro
  - U.S. Grant HS
  - Del City HS
- Target audience is female
- Typical meeting structure
  - Socialize & Eat
  - Ice Breaker
  - Activities
  - Game
  - Journal

- UCO hosts Central Regional Fair
- Various Categories (and Subcategories)
  - Mathematics
    - Analysis
    - Combinatorics, Graph Theory, and Game Theory
    - Geometry and Topology
    - Number Theory
    - Probability and Statistics
    - Other
- Two Divisions
  - 6th Graders
  - 7th - 12th Graders
- Regional winners move on to the state competition

- Student Researcher

- Adult Sponsor

- Qualified Scientist

- Designated Supervisor

- Early October: School establishes Scientific Review Committee (SRC) and Institutional Review Board (IRB) to evaluate projects
- Late October: Submit names of SRC and IRB to fair committee
- January: Local/district science fairs
- February 1: Register for regional fair
- February 3: Applications are reviewed by regional committee
- Mid/late February: Regional competition
- March: State competition

- Served as judge for a few years

- Worked on grant for current teachers

- Approached by Biology colleague

To show how the scientific process/method is used in mathematical research

Circle in a Box
By: Sam Vandervelde

- Chapter 5: The Game of Criss-Cross (Euler Characteristic)
- Chapter 7: King Chickens (Graph Theory)
- Chapter 10: Heads or Tails (Probability and Expected Value)

Overview: Between every pair of chickens, there's a pecking order. (This can be represented by a digraph.) *K* is a king chicken if, given any other chicken *C*, either *K* pecks *C* or there exists a chicken *F* such that *K* pecks *F* and *F* pecks *C*.

Possible Problems:

- Given a particular pecking order, are you guaranteed a king?
- Given a particular pecking order, prove that a particular chicken is king?
- How many possible pecking orders are there given *n* number of chickens?

Overview: Flipping (fair) pennies

Possible Problems:

- How many outcomes are possible when flipping a coin n times?
- Given an unfair coin, how could you determine the probability that the coin comes up heads?
- Consider all the possible outcomes from tossing a fair coin n times. In how many cases will the first tail occur on the very first flip? In how many cases will it occur on the second flip?

Overview: On a blank sheet of paper, draw an equilateral triangle and 3 vertices in each corner. Draw additional vertices within the interior. Players alternate turns drawing a single straight line segment joining any two points as long as the segment does not pass through any other points or segments. The winner is the last player able to make a legal move.

Possible Problems:

- Is the first or second player guaranteed to win with n interior vertices? Why?
- The expression $V - E + F$ is known as the Euler characteristic. Prove that the Euler characteristic of any completed game board is equal to 2.

- Which player is guaranteed to win if there are *x* outer vertices and *y* inner vertices?

- Does it matter how the vertices are placed on the board?

- Arithmetic sequences