

The Central States Section of the Combustion Institute

HIGH SCHOOL TEACHER GRANT PROGRAM

SUMMARY REPORT

Year 1 Awardee: Mr. Tim McLinden

July 30, 2013



In January 2012, Mr. Tim McLinden of Catholic Central High School (Springfield, Ohio) received a grant after competitive review process from the Central States Section of the Combustion Institute. Mr. McLinden proposed to center efforts on increasing the exposure of combustion to first-year chemistry students. As a result of his efforts and collaboration with Dr. Vince Belovich (US Air Force Research Laboratory, Dayton, Ohio), the following activities were completed as part of the grant:

- Heavier emphasis placed on combustion throughout the whole year. This was beneficial since it made the experiential laboratories (described below) and guest instruction (Dr. Belovich, described below) more meaningful.
- Experiential laboratory on the operation of a Bunsen burner. This was beneficial since it enabled students to understand the concept of combustion as a reaction involving a hydrocarbon fuel and oxygen, with a proper ratio of the two necessary for clean combustion.
- Experiential laboratory on liquid ethanol combustion. This was beneficial since it enabled to students to visualize the physical processes involved in combustion (e.g., liquid vaporization, premix zone, and flame lift off).
- Experiential laboratory on magnesium metal combustion. This was beneficial since students were able to see a metal-based combustion (i.e., rapid and exothermic) process as opposed to a slow oxidation process (e.g., iron rusting).
- Increased practice with balancing equations. This was beneficial since students were able to see combustion as a balanced chemical reaction and have discussions about fuel-lean, fuel-rich, and stoichiometric mixture ratios.
- Experiential laboratory on measuring CO₂ and O₂ products from ethanol / air combustion. This was beneficial since students were able to verify their theoretical calculations from balanced combustion reaction to measurements.
- Guest classroom instruction by area combustion researcher (Dr. Vince Belovich). This was beneficial since the students learned from Dr. Belovich several practical and theoretical aspects of combustion (e.g., parts of a jet engine, laminar vs. turbulent flames, and pre-mixed vs. diffusion combustion), observed demonstrations (e.g., burning of ethanol vs. jet fuel), learned what it's like to have a career / profession in combustion (specifically) and STEM (generally), learned about the importance of combustion, and learned about the future needs of combustion development.

The following were identified strengths of the program:

- Early exposure to combustion concepts helped students gain more from the laboratories and guest instruction.
- Teacher attendance and participation at the Combustion Institute meetings helped provide material for instructional instruments and laboratories.
- Students enjoyed using the high-tech equipment purchased with the grant money.
- Guest instruction by Dr. Belovich was an excellent capstone to the year's emphasis on combustion.

The following are lessons-learned:

- Some experiments planned will require more time to design and engineer for in-class use.

Mr. McLinden intends to continue the combustion-based instruction in his chemistry classes for the foreseeable future and hopes to make videos of the classroom demonstrations for YouTube posts and other media dissemination channels.