A Template for ATE Modules with Industry-based Problem Scenarios

The following steps outline a process for developing a new module for use in the SC ATE ET Core Curriculum. New ATE modules may be developed to:

- Offer new and different scenarios for new ET Core classes
- Create modules in areas of physics, chemistry, or engineering technology that need additional attention in the curriculum.
- Provide modules that adapt the ATE materials for other technical programs.

The process outlined below is most effective when a team of professionals (multidisciplinary faculty and industry representatives) work together to develop the project.

Steps to follow:

1. Identify a broad science/technology content area such as "Structure of Matter" or "Global Data Measurement and Location".

2. List key student competencies to be learned in the project. Science, mathematics, communications (to include English and Speech), and engineering technology competencies should be identified. A DACUM process may be used to identify appropriate competencies that meet accreditation criteria and are consistent with industry and state standards.

3. Select a problem scenario. Generally, one person will present an idea for a problem and the team will critique and "flesh out" the idea. Brainstorm industry applications of the target science/technology. Workplace research may be necessary to determine a realistic industry problem scenario that answers for students, "why am I learning this?" and requires students to use newly-learned knowledge and skills. An industry representative or someone with industry experience on the team is invaluable in the process of creating good problems. As a team, develop at least one possible solution to the problem. Remember to make the problem "open-ended" with multiple possible solutions.

4. List objectives (student outcomes), at least one from each discipline, for the module.

5. Describe student performance expectations to share with students.

6. Write discipline-specific workshops or student lessons in physics (or chemistry), mathematics, communications, and engineering technology. Active (e.g., collaborative, inquiry-based, hands-on) learning, teaming, and problem-solving methods should be incorporated in the lessons.

7. Develop supporting material such as background information on the topic, drawings, concept maps, content strands, and student assessment rubrics and strategies.

8. Pilot test the module in an ATE ET Core class and provide feedback on attached form.

9. Revise the module and prepare "notes to the instructor" based on faculty feedback from the pilot test.

10. Prepare final draft of the completed template that will be used to prepare teacher and student materials.

11. For assistance with publishing and distributing a final product contact www.scate.org/publishmodule.

ET Core Module Development TEMPLATE

Science/Technology Content Area:

Student Competencies:

Science:

Mathematics:

Engineering Technology:

Communications:

Problem Scenario

Science/technical background information
"Setting the Stage"

Module Objectives

1.

2.

3.

4.

Student Performance Expectations

Content Strands

Science	Mathematics	English/Speech	Engineering Technology

Concept Map

Student Workshop Topics

Science

Communications

Mathematics

Engineering Technology

Student Assessment Strategies

Equipment specific to this module

Notes to the Instructor (to be completed after the module has been pilot tested)

Science/Technology Content Area:

Electrical Current

Student Competencies:

Science:

Demonstrate the conceptual understanding of current as the rate of flow of electrical charge.
Apply Kirchhoff's current law to circuits with multiple current paths.

Mathematics:

Calculate conductance from resistance values and vice versa. Use exponents, scientific notation, and engineering and prefix notation to express values of resistance. Graphically analyze voltage-current data for ohmic resistors to determine resistance. Solve Ohm's law problems by algebraically manipulating Ohm's law equation for unknown quantities. Solve power relationships for an unknown quantity.

Engineering Technology:

Use appropriate electrical symbols to create electronic schematics.
Interpret schematic diagrams to identify electronic components and construct electrical circuits.
Demonstrate engineering technology-appropriate computer skills. Use appropriate engineering technology terminology. Apply the concept of electrical potential and electrical potential difference to differentiate between voltage with respect to ground and voltage across a device.

Communications:

Employ problem-solving skills to solve a team task.
Use appropriate human relations skills.
Demonstrate various listening skills.
Work in teams to collaborate on assignments.
Use various media to obtain information.
Demonstrate ability to conduct primary/secondary research. Collaborate with others to obtain information. Format appropriate documents (letters, memos, manuals, reports). Demonstrate the four C's of writing: clear, concise, correct, complete.

Problem Scenario

The Vulcan New Metals fabrication shop has just hired you. The company wants to expand its product line from metal containers to trailer systems. The trailer's lighting system will be connected to the towing vehicle. Most vehicles' electrical fuse systems, however, are not designed to handle a trailer. Therefore, you must change the parking light fuse when adding a trailer, as well as recommend to the owner the modifications to a vehicle's electrical system to accommodate the trailer's lighting system. Your technician team has been asked to do the following:

1. Determine the additional current load placed on a vehicle's circuit by a standard trailer lighting system. The trailer lighting system includes four side marker lamps and two tail lamps.
2. Propose an amendment to the section of the vehicle's manual that deals with trailer towing.
3. Compose a written explanation to the design team.

Science/technical background information
"Setting the Stage"

The fuse is one of the most basic circuit elements. It is used to protect electrical equipment in the home, in automobiles, in industry, and elsewhere. The fuse, a bimetallic conductor through which current passes, is the connection between the equipment and its power source. If the equipment does not work properly and draws excessive current, the fuse "blows," disconnecting the equipment from the power source and preventing further damage. In other words, as the current increases, the metal in a fuse heats and begins to melt if the current exceeds the rated value.

A fuse plays an important role in electrical circuits because it ensures that the current does not exceed a safe level. In industrial plants and homes, power must be limited to ensure that the current through the lines is within rated values. Therefore, fuses and circuit breakers are installed where power enters the installation. In the case of industrial plants and homes, circuit breakers have replaced fuses for this control and can be reset when the breaker has been tripped. However, fuses are still in wide use for the protection of circuits because of the low cost of the fuse compared with the high cost of the circuit breaker.

Another important concept for electrical circuits is the rule concerning the flow of current from a single path into more than one path. Consider a wire that splits in two paths (see the figure above). The current flowing into the junction (I_{in}) equals the sum of the currents (ΣI_{out}) leaving the junction.

This rule is known as Kirchhoff's current rule (KCR) or Kirchhoff's current law (KCL), and it allows technicians to determine the amount of current in parallel circuits.

Module Objectives

1. Construct an effective wiring diagram to solve a specific wiring problem.
2. Use calculators and algebra to solve Kirchhoff's current law problems.
3. Explain team roles and how they are used to develop a team solution.
4. Write a well-organized, well-developed, and grammatically and mechanically acceptable procedure.

Student Performance Expectations

Students will be evaluated individually and in teams. The evaluation will include problem-solving and teaming skills used by students and student teams.

Students will have opportunities for self evaluation, peer evaluation, and team evaluation.

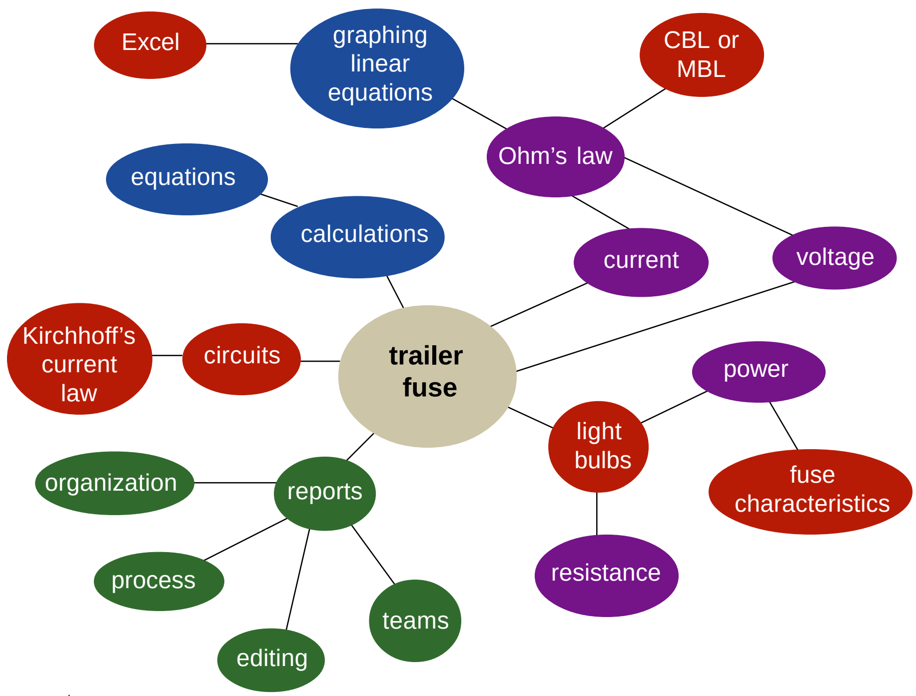
Individual instructors will test and grade students individually on the content of workshops and activities.

Team products will be evaluated by faculty teams.

Content Strands

Science	Mathematics	English/Speech	Engineering Technology
Ohm's law	Linear relations	Process instructions	Introduction to MathCAD
Kirchhoff's law	Graphing linear equations	Peer editing	Interpreting technical data
Resistance	Using a scientific/graphing calculator	Team roles	Using DMM measures for Ohm's law and Kirchoff's law
Power		Organizing body of a report	Electrical safety

Concept Map



Student Workshop Topics

Science

Ohm's law

KCR/KCL

Parallel Circuits

Communications

Preparation of a written proposal

Writing instructions and procedures

Organizational principles, Peer editing

Mathematics

Algebraic manipulations and graphics

Operations with scientific/engineering notation

Operations involving exponents

Engineering Technology

Reading schematics/data sheets and interpreting graphics

Elements of teams and team roles

Student Assessment Strategies

Faculty teams will evaluate the technical accuracy of written team reports on the electrical impact of a trailer lighting system.

Faculty will assess individual student performance in discipline-specific workshops, labs, and activities.

Teaming skills and problem-solving skills will be evaluated by faculty, peers, and students' self-assessments.

Equipment specific to this module

Light bulbs (5 watt and 7 watt)
Sockets for lights
Resistors
Power supply DC/AC
Digital multimeter (DMM)
CBL/MBL voltage & current probes
Software — electrical circuit simulation

Notes to the Instructor (to be completed after the module has been pilot tested)

1. Use the evaluations of a student's performance in Electrical Module 1 to establish placement in a permanent team for the remaining modules.
2. Teaming skills need to be enhanced. "Jigsaw" on team roles.
3. This project as stated is "ill structured," similar to one that might be given by a supervisor. The students must request or research several pieces of information on the types of bulbs used in a trailer system. This requirement adds to the problem-solving process of identifying what students know and what they need to know.
4. The students can discover Kirchhoff's current law (KCL) using an exercise with several different light bulbs in parallel and with CBL/MBL measurements. Once the rule is discovered, it can be reinforced with a circuit simulation program. Demonstration of KCL with water gives visual learners a good visual representation.
5. Students can discover Ohm's law using the CBL/MBL systems.
6. If students attempt to find the current by measuring the resistances as in Electrical Module 1 and applying Ohm's law, they will arrive at an incorrect answer. They have measured the "cold" resistance of the light sources. They can not use an ohmmeter to determine resistance in this case. They must make a dynamic measurement using Ohm's law. Therefore, this project can be used to reinforce the concepts of resistance and temperature found in Electrical Module 1.
7. The students can use Ohm's law data and graphics to understand the relationship between slope and resistance.
8. Operations with scientific and English notation can be used to show factor analysis and the laws of exponents.
9. Students can build circuits in physics or technology and write a procedure on how to build the circuits.

Pilot Test Faculty Response Form

Team Members: ______________________________

Reporting Instructor's Name: ______________________________

Course Titles/Numbers: ______________________________

Module Tested: ______________________ *Term/Date* ______________

Length of Module (number of class hours): ______________________

I. Please comment on the effectiveness of the following and add any ideas, examples, lesson/assessment strategies that you used.

a. Problem Scenario: (student interest, clarity, feasibility, difficulty level, team success in solving the problem)

b. Level of student competencies (too high, too low?):

c. Workshop topic list: (did you conduct all suggested workshops? others?)

d. Content strands: (is list accurate? discipline topics additions?)

e. Assessment strategies: (please attach your successful assessment instruments, rubrics, team evaluations)

II. How did this module work in your class?
Please rate (circle) on a scale of 1 (low) to 5 (high).

a.	Ease of use of material	1	2	3	4	5
b.	Accuracy of material	1	2	3	4	5
c.	Appropriate content	1	2	3	4	5
d.	Student teaming/participation	1	2	3	4	5
e.	Student/team success	1	2	3	4	5

Comments: