📆Date:	Topic: What is Research?	Time Required: 120 minutes

🎯**Learning Target/Objectives:**

- Explain what research is, why it is important and how it is conducted
- Explain the Scientific Method and its steps
- Explain the Engineering and Design Process
- Design a research project that applies the principles of research and engineering

📜**Vocabulary:**

- Research
- Scientific Method
- Engineering Design Process
- Critical Thinking
- Collaboration
- Creativity

Color Legend:
Red = Essential
Blue = Enrichment
Purple = In Depth

❓**Guiding Questions:**

- What is research?
- Compare and contrast research across three industry areas of advanced manufacturing energy systems; food production and manufacturing; and pharmaceutical production
- Describe the relationship between the Scientific Method with the Engineering and Design Process.
- What are the steps in the Engineering Design Process and what is the significance of each?

📚**Lesson Design Details:**

Activity 1: Students should discuss key aspects of research across the three industry areas of advanced manufacturing energy systems, food production and food manufacturing, and Pharmaceutical production.

Activity 2: Students will demonstrate their understanding of research and the engineering and design process by designing research and engineering projects. In these projects they describe each step of the scientific method for the project and the engineering and design. Highly creative students may be able to synthesize these projects into one that incorporates the attributes of both.

Activity 3: Students will present their hypothetical research projects as a proposal for funding.

📝**Key Points:**

- **Research** is the process of seeking out answers to a specific problem. The process includes the creation of new knowledge and/or the use of existing knowledge in a new and creative way so as to generate new concepts, methodologies and understandings.
- **Research is a systematic process** of investigating a topic through the collection and analysis of data, aiming to discover new knowledge, expand understanding, or test existing

theories on a subject, often involving a structured approach like the scientific method to reach reliable conclusions.

  - To gain new insights, answer questions, or solve problems by gathering and interpreting information.
  - Methodical approach:
  - Research typically follows a structured process, including defining a research question, formulating a hypothesis, collecting data, analyzing results, and drawing conclusions.
  - Data collection:
  - Researchers gather information through various methods like experiments, surveys, interviews, observations, or document analysis.
  - Critical analysis:
  - Collected data is carefully examined and interpreted to identify patterns, trends, and relationships

- **Engineering Design Process** is the process of seeking out answers to a specific problem. Moreover, the engineering design process emphasizes open-ended problem solving and encourages students to learn from failure.
  - **Ask:** The first and most important five step process is to ask questions. Asking questions helps students define the problems. Some questions that are most helpful are: (1) who is having the problem, and (2) what exactly the need is. This helps set the goal for the research. This is also useful for the student to consider why it's important to solve the problem or what the benefits are.
  - Defining the problem allows the students to focus on what they are trying to achieve, which is critical for the rest of the process.
  - **Imagine:** Once the Ask (problem or need) has been defined clearly, it's time to come up with ideas about how to solve the problem. Student teams need to imagine and stay open-minded and talk through the pros and cons of each idea. Students should not judge any ideas, but rather list and gather as many options as possible. This is called brainstorming. Brainstorming can include some research where students look at what other solutions designers have created. It is possible one of the solutions already discussed could be refined and improved upon to meet the need defined in the first stage.
  - Once all the ideas have been discussed, it's time to narrow down the solution that the team will start to design and build. This may mean students will need to draw out some of the solutions and what they do so the team can discuss the benefits or drawbacks of the idea.
  - **Plan:** Students should begin design centered thinking. After one idea has been selected, the design process should begin. This stage often includes drawings of the solution, as well as some documentation that explains what it does, how it fits the need, and how it should be

used. This can include brainstormed items. Encourage students to dream up their designs on paper while others are more eager to get to the next stage.

- **Create**: With a design sketch or more in hand, this is the time to begin creating the prototype. A prototype is a smaller version of the actual thing the students are trying to create. Having a scaled-down version can help kids see some problems or challenges in the design. It is common to go back and solve these issues before moving on to the actual building of the solution.
- **Improve:** Once the prototype has been created it is time to test and improve, as needed. This is where some issues and problems can surface. Failures and issues can strengthen problem-solving, teamwork, and critical thinking skills. Testing can take time to overcome problems in the design.

📝**Materials/Resources:**

- Digital Journal (Google Slides RECOMMENDED):

📋**Closing (Check for Understanding):**

- Discussion Review - students will share
  - Answers to Guiding Questions
  - Any surprises they experienced

Subject	Middle School Standards (NC)
Science	
Mathematics	

Computer Science	

ITEEA STEL (Standards for Technology and Engineering Literacy) for Middle School

STEL Standard (Grades 6-8)	Benchmark (Grades 6-8)	Supporting Description Relevant to DeSIRELesson01A
Standard 2: Core Concepts of Technology and Engineering		
Standard 4: Impacts of Technology		
Standard 5: Influence of Society on Technological Development		
Standard 6: History of Technology		

Standard 7: Design in Technology and Engineering Education		
Standard 8: Applying, Maintaining, and Assessing Technological Products and Systems		

ISTE Standards (Student Standards 1.1–1.7)

Content Area Standard	ISTE Standard	Supporting Description Relevant to DeSIRELesson01A
1.3 Knowledge Constructor		
1.5 Computational Thinker		

1.7 Global Collaborator		