Chemical Reactions

Grade: 5	**Recommended Timeframe:** Seven to nine 45 minute class periods to complete all lessons.
Unit Overview: Stephanie Kwolek is the inventor of Kevlar, a polymer composite material. In this set of explorations, students are introduced to Stephanie through her DuPont commercial and a biography. They explore a simple polymer and then are given several options to create different composites. The characteristics of these composites are tested for strength, durability, elasticity, and other parameters. Students are invited to select a composite they have engineered and then develop a technical guide and application for their product.	
Essential Questions: What are the properties and different structures of polymers and what chemical reactions affect polymer properties and structure?	**Major Concept**s Science - Structure and Properties of Matter, Chemical Reactions Technology – Tools for measurement are used and observations can be recorded using media devices. Engineering – Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a prototype that can be improved. Math - Reason abstractly and quantitatively, Convert measurements, measure and graph quantities.
Suggested Lesson Sequence – Go to the link for full instructions, videos and demonstrations for each of the lessons below. https://sites.google.com/a/eou.edu/stem-stories/stephanie-kwolek-1 Lesson 1 (“Establishing Context”) - The Stephanie Kwolek Story (20-30 mins) Lesson Overview: This lesson introduces students to Stephanie Kwolek, a chemist and the inventor of Kevlar, a polymer composite. Lesson 2 – Getting Started; Brainstorming Questions to Investigate (20 – 30 mins) Lesson Overview: Students brainstorm questions and ideas about polymers and the Stephanie Kwolek story. Lesson 3 – Polymers (45 – 60 mins) Lesson Overview: Students explore polymers using a natural polymer, gelatin. Lesson 4 – Chemistry of Materials (45 – 60 mins) Lesson Overview: Students conduct tests on different white powders. Lesson 5 – Chemical Reactions (45 – 60 mins) Lesson Overview – Students observe and explore the differences between synthesis, analysis and replacement chemical reactions. These reactions can be viewed on the videos provided in the link above or can be done as demonstrations. Lesson 6 – Atomic Models (45 mins)	

Lesson Overview – Students make models of different molecules.

Lesson 7 – Enhancing and Testing a Polymer (45 – 60 mins)
Lesson overview – Students add borax to their gelatin mixture to demonstrate and observe the process of polymerization. Next students develop a standard for measuring a characteristic of the polymer (memory, stretch, stickiness).

Lesson 8 – Designing a Composite (90 mins)
Lesson Overview – Students invent/engineer a composite to solve a problem.

Materials, Tools, & Technology
Lessons 3: Gelatin, hot water, mixing cups, stir sticks, clothes pins, aluminum foil

Lesson 4: Hand lens, pH paper, eye dropper, vinegar, alum, baking soda, borax, citric acid, crème of tarter, salt, sugar, borax. Other white materials can be used such as sand and Epson salt, cotton balls

Lesson 5: Yeast, food coloring, dishwashing soap, Hydrogen peroxide, warm water.

Lesson 6: Gum drops, toothpicks

Lesson 7: Gelatin, hot water, aluminum, borax, paperclips

Lesson 8: Gelatin, warm water, crème of tartar, baking soda, stir stick, mixing cup, other white powders, iron filings, cotton

Vocabulary
Polymer
Composite
Ratio
Polymerization
Chemical reaction
Model

Additional Lesson Ideas:
Extensions – Make Bouncy Balls, Oobleck, Slime

STEM Professional Involvement Ideas

- Chemist

Standards

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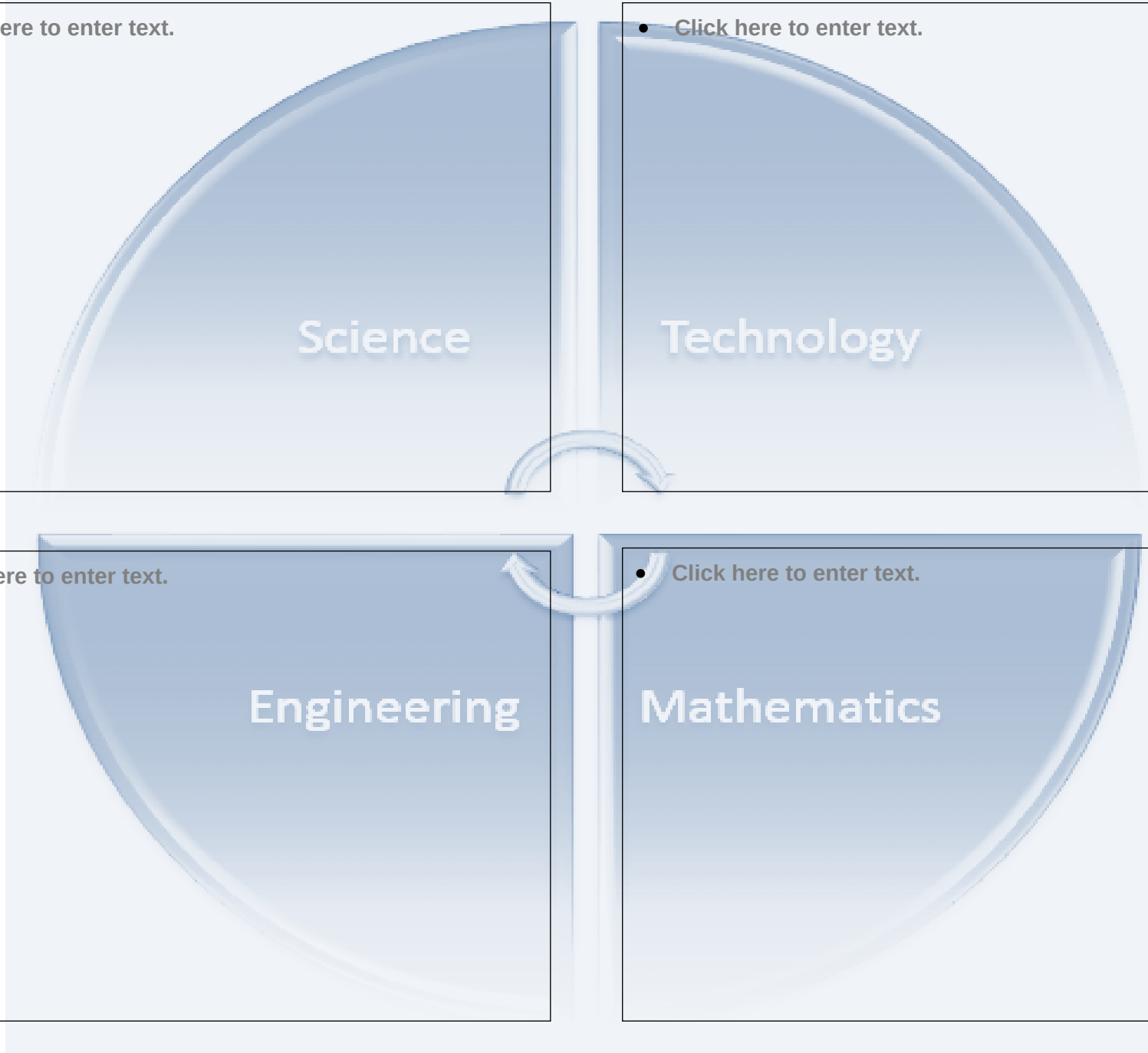

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Notes

Appendices

Appendix A: Teacher Resources
Appendix B: Student Resources
Appendix C: Literacy Connections