**Subject area/course**: Mathematics/Algebra 2

**Grade level/band**: 9-12

**Task source**: Summit Public Schools; Author: Hai Tran

**Cooling Project**

**TEACHER'S GUIDE**

1. **Task overview**:

This task uses a new product, Joulies, which claims to help keep hot drinks hot longer. Students will study the change in temperature of an object as it cools and model its temperature as a function of time and use their knowledge of Algebra 2 in order to build a mathematical model of a cooling object.

1. **Aligned standards:**
2. **Primary Common Core State Standards**

[CCSS.Math.Practice.MP1](http://www.corestandards.org/Math/Practice/MP1/) Make sense of problems and persevere in solving them.

[CCSS.Math.Practice.MP2](http://www.corestandards.org/Math/Practice/MP2/) Reason abstractly and quantitatively.

[CCSS.Math.Practice.MP4](http://www.corestandards.org/Math/Practice/MP4/) Model with mathematics.

[CCSS.Math.Content.HSF.BF.A.1](http://www.corestandards.org/Math/Content/HSF/BF/A/1/) Write a function that describes a relationship between two quantities.

[CCSS.Math.Content.HSF.LE.A.1](http://www.corestandards.org/Math/Content/HSF/LE/A/1/) Distinguish between situations that can be modeled with linear functions and with exponential functions.

[CCSS.Math.Content.HSF.LE.A.2](http://www.corestandards.org/Math/Content/HSF/LE/A/2/) Construct linear and exponential functions, including arithmetic and geometric sequences, given a graph, a description of a relationship, or two input-output pairs (include reading these from a table).

1. **Secondary Common Core State Standards**

[CCSS.Math.Practice.MP5](http://www.corestandards.org/Math/Practice/MP5/) Use appropriate tools strategically.

[CCSS.Math.Practice.MP6](http://www.corestandards.org/Math/Practice/MP6/) Attend to precision.

1. **Critical abilities**

Research: Conduct sustained research projects to answer a question (including a self-generated question) or solve a problem, narrow or broaden the inquiry when appropriate, and demonstrate understanding of the subject under investigation. Gather relevant information from multiple authoritative print and digital sources, use advanced searches effectively, and assess the strengths and limitations of each source in terms of the specific task, purpose, and audience.

Analysis of Information**:** Integrate and synthesize multiple sources of information (e.g., texts, experiments, simulations) presented in diverse formats and media (e.g., visually, quantitatively, orally) in order to address a question, make informed decisions, understand a process, phenomenon, or concept, and solve problems while evaluating the credibility and accuracy of each source and noting any discrepancies among the data.

Experimentation and Evaluation**:** Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text. Evaluate hypotheses, data, analysis, and conclusions, verifying the data when possible and corroborating or challenging conclusions with other sources of information.

Communication in Many Forms**:** Use oral and written communication skills to learn, evaluate, and express ideas for a range of tasks, purposes, and audiences. Develop and strengthen writing as needed by planning, revising, editing, and rewriting while considering the audience.

Use of Technology**:** Present information, findings, and supporting evidence, making strategic use of digital media and visual displays to enhance understanding. Use technology, including the Internet, to research, produce, publish, and update individual or shared products in response to ongoing feedback, including new arguments or information.

Interpersonal Interaction and Collaboration**:** Develop a range of interpersonal skills, including the ability to work with others, to participate effectively in a range of conversations and collaborations.

Modeling, Design, and Problem Solving**:** Use quantitative reasoning to solve problems arising in everyday life, society, and the workplace, e.g., to plan a school event or analyze a problem in the community, to solve a design problem or to examine relationships among quantities of interest. Plan solution pathways, monitoring and evaluating progress and changing course if necessary, and find relevant external resources, such as experimental and modeling tools, to solve problems. Interpret and evaluate results in the context of the situation and improve the model or design as needed.

1. **Time/schedule requirements:**

This task will take approximately one week to complete.

1. **Materials/resources:**
* Cooling Project - Student Guide
* “Joulies Sales Pitch” video (<https://docs.google.com/file/d/0Bxzqgmq1mdQQcFZObFI5YWt4Tm8/edit>)
* “No Joulies” video (<https://docs.google.com/file/d/0Bxzqgmq1mdQQRkRyN2xGNUQzUnc/edit>)
* “Joulies” video (<https://docs.google.com/file/d/0Bxzqgmq1mdQQLXNvUW1vV2dlNVk/edit>)
* Access to Desmos free online graphing calculator (https://www.desmos.com/)
1. **Prior knowledge:**

None listed.

1. **Connection to curriculum:**

None listed.

1. **Teacher instructions:**

Day 1

* Provide students with a copy of the student task and the Cooling Project Student Guide Handout.
* Choose appropriate models.
* Have students watch the Joulies Sales Pitch and record their initial reactions to the video.

Day 2

* Students will make a hypothesis and set up an experiment to test whether or not they think the product works. Students should consider variables, materials, experimental set up, and procedures.

Day 3

* Students will perform their experiment after their teacher has approved their plan.

Day 4

* Draft a model and analysis of the experiment data using the Student Guide.

Day 5

* Finalize the draft of model and analysis. Have students exchange data with a peer. Students will read through their peers experiment and data analysis and makes notes about whether they agree with their peer’s analysis and model functions. Students will record a summary and evaluation of their peer’s work in the student guide.

Day 6

* Plan presentation of experiment results

Days 7 & 8

* Present experiment results
1. **Student support:**

None listed.

1. **Extensions or variations:**

None listed.

1. **Scoring:**

Student work can be scored using the Summit Public Schools Cooling Project Rubric.