Unit: Food and Cooking
Inquiry Task
What’s for Dinner?

Subject Area: Physical Science
Grade: 8

Standards (Content and Characteristics):

S8P2. Students will be familiar with the forms and transformations of energy.
   d. Describe how heat can be transferred through matter by the collisions of atoms (conduction) or through space (radiation). In a liquid or gas, currents will facilitate the transfer of heat (convection).

Supporting standard:

S8P2. Students will be familiar with the forms and transformations of energy.
   b. Explain the relationship between potential and kinetic energy.
   c. Compare and contrast the different forms of energy (heat, light, electricity, mechanical motion, sound) and their characteristics.

S8CS1. Students will explore the importance of curiosity, honesty, openness, and skepticism in science and will exhibit these traits in their own efforts to understand how the world works.
   a. Understand the importance of—and keep—honest, clear, and accurate records in science.
   b. Understand that hypotheses can be valuable even if they turn out not to be completely accurate.

S8CS2. Students will use standard safety practices for all classroom laboratory and field investigations.
   a. Follow correct procedures for use of scientific apparatus.
   b. Demonstrate appropriate techniques in all laboratory situations.
   c. Follow correct protocol for identifying and reporting safety problems and violations.

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S8CS4. Students will use tools and instruments for observing, measuring, and manipulating equipment and materials in scientific activities utilizing safe laboratory procedures.
   b. Use appropriate tools and units for measuring objects and/or substances.
   c. Learn and use standard safety practices when conducting scientific investigations.

S8CS6. Students will communicate scientific ideas and activities clearly.
   a. Write clear, step-by-step instructions for conducting scientific investigations, operating a piece of equipment, or following a procedure.
   b. Write for scientific purposes incorporating information from a circle, bar, or line graph, data tables, diagrams, and symbols.
   c. Organize scientific information in appropriate tables, charts, and graphs, and identify relationships they reveal.

S8CS7. Students will question scientific claims and arguments effectively.
   a. Question claims based on vague attributions (such as “Leading doctors say...”) or on statements made by people outside the area of their particular expertise.
   d. Recognize that there may be more than one way to interpret a given set of findings.

S8CS8. Students will be familiar with the characteristics of scientific knowledge and how it is achieved.
   Students will apply the following to scientific concepts:
   a. When similar investigations give different results, the scientific challenge is to judge whether the differences are trivial or significant, which often requires further study. Even with similar results, scientists may wait until an investigation has been repeated many times before accepting the results as meaningful.
   b. When new experimental results are inconsistent with an existing, well-established theory, scientists may pursue further experimentation to determine whether the results are flawed or the theory requires modification.
   c. As prevailing theories are challenged by new information, scientific knowledge may change.

S8CS9. Students will understand the features of the process of scientific inquiry.
   Students will apply the following to inquiry learning practices:
   a. Investigations are conducted for different reasons, which include exploring new phenomena, confirming previous results, testing how well a theory predicts, and comparing different theories. Scientific investigations usually involve collecting evidence, reasoning, devising hypotheses, and formulating explanations to make sense of collected evidence.
   b. Scientific investigations usually involve collecting evidence, reasoning, devising hypotheses, and formulating explanations to make sense of collected evidence.

c. Scientific experiments investigate the effect of one variable on another. All other variables are kept constant.
d. Scientists often collaborate to design research. To prevent this bias, scientists conduct independent studies of the same questions.
e. Accurate record keeping, data sharing, and replication of results are essential for maintaining an investigator’s credibility with other scientists and society.

Enduring Understandings:

- Energy is neither created nor destroyed but can be transformed.
- Energy can be transferred by radiation, conduction, and convection.

Essential Question:

- How can we use radiation, conduction, and convection to transfer heat efficiently during cooking?

Pre-Assessment: Create a web diagram or concept map with “How heat cooks things” in the middle.

<table>
<thead>
<tr>
<th>Outcome/ Performance Expectations</th>
<th>The student will experimentally determine what method for cooking a particular food will provide the best results and relate the cooking method to the types of heat transfer.</th>
</tr>
</thead>
</table>
| Write a concept statement...*How would you formulate an expert idea?* | Concept: Heat may be transferred through matter (conduction), through space (radiation), or through currents in fluids (convection). Examples to support the concept:
- Students will describe examples of how cooking foods by different methods utilizes radiation, conduction, and/or convection.  
- Students will formulate ideas about how changing the method of heat transfer affects the outcome for a particular food. For example, potatoes can be cooked in a variety of ways. How does heat transferred in different ways affect the results? |

| Write a concept statement / question | Display potatoes that have been baked, boiled, and fried.  
  - What methods are used to cook the potatoes, and other food?  
  - What method of cooking do you think cooks food best? Why?  
  - How is heat transferred in cooking the potatoes?  
  - How could you test your idea on another food?  
  - What would your independent variable be?  
  - What variables would you have to control?  
  - What would be your dependent variable?  
  - What would be the limitations of your study?  

Teacher Note: You will need to have methods of cooking food available to students. Students will need to pick a substance that can be cooked via microwave or solar heating, convection oven or boiling, and regular oven. Before students use any heat-generating device, GO OVER SAFETY PROCEDURES INVOLVING THE USE OF HOT OBJECTS, ESPECIALLY BOILING WATER. PROVIDE OVEN MITTS OR POT HOLDERS, BUT REALIZE THAT IF THEY GET WET, THEY ARE NO LONGER EFFECTIVE. This activity could be done in conjunction with the construction of a solar cooker, and hot dogs could be the food of choice. (See culminating task choices in the framework.) |

| Identify necessary data and observations | Determine a food that you can cook in different ways.  
  - What will you cook?  
  - What methods will you use to cook it in order to demonstrate all three methods of heat transfer?  
  - How could you set up your study so that your cooking methods are comparable?  
  - How will you evaluate your results?  
  - How do you know your results could be repeated if another class did your experiment?  
  - How will you eliminate preconceptions on the part of evaluators regarding which method of cooking is best?  
After considering these requirements, write a plan for testing the cooking methods on your chosen food. Present this plan to the teacher for approval before conducting your experiment with the food. |

Students should use comparable cooking times or comparable temperatures. They should be aware of controlling variables. An initial substance should be subdivided so that identical quantities are cooked in each trial. Students should be encouraged to use multiple evaluators i.e., they will evaluate each other’s products of cooking.

Teacher Notes: A rubric for determining food quality should be developed BEFORE the experiment begins. This could be a class activity or left to each experimenter. Students will need to decide what the word “best” incorporates as it relates to food preparation—should it include taste and texture? Are there other factors such as ease of preparation that should be included in the rubric? The use of a numerical rubric will facilitate data handling and conclusion making. See Organizer for Cooking Comparison at the end, for a sample rubric.

To eliminate bias, discuss the use of a single blind (The food product is identified by number and only the experimenter knows what the number means. The evaluator does not know how the food was cooked) or double blind experiment (Someone else that does not know how the food was cooked poses the questions to the evaluators so that neither the evaluators nor the questioner knows how the food was cooked.)

| Write questions or activities to use or apply the concept (represent, model, visualize, or design new experiments). | • What method was best, according to your criteria?  
• Did each of your cooking methods utilize only one method of heat transfer?  
• Was all the energy transferred in each method? If not, did it disappear? How can you account for it?  
• How could you increase the efficiency of heat transfer with each method of cooking?  
• What energy conversions were involved in your cooking of food?  
• What forms of energy were involved?  
• Was potential or kinetic energy involved? Was one converted to the other? |

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## Homework/Extension

List all the foods served in one meal. Create a data table that shows how heat was transferred in the cooking of each food served in the meal.

Research the energy efficiency of various common cooking methods. Also research the energy efficiency of different sources of energy used in cooking. Include solar, electric, natural gas, and propane. Explain the relationship of efficiency to the Law of Conservation of Energy. (If energy is not created or destroyed, what happens to energy that is not actually used in the cooking?)

## Instructional Tasks Accommodations for ELL Students

Assign the ELL student a specific task at each stage of the lab. Confer with the team frequently to assess comprehension and progress. Provide a handout that includes all required vocabulary words in a word bank with basic definitions as needed.

## Instructional Tasks Accommodations for Students with Disabilities

Students with developmental disorders such as Asperger's Syndrome, or students having Autistic tendencies display impaired social interactions and repetitive patterns of behavior. Since these activities involve close interactions such as eating, be sure the student has a say in which group he/she will be involved in. If possible, discuss the lab with the student ahead of time along with discussion about specific roles the student would have in data collection, assembly of lab report, etc. The teacher may want to assess focus and progress at timed intervals throughout the lab. Students with organizational deficits may need reminders to record needed data for each activity before moving on to a new activity.

## Instructional Tasks Accommodations for Gifted Students

Have students visit the following web-based resource:

*The Science of Food*

[http://www.exploratorium.edu/cooking/](http://www.exploratorium.edu/cooking/)

Ask them to identify evidence of the importance of heat transfer in food preparation.

Gifted students could be required to provide the same amount of energy to each sample. This would necessitate research into:

1. heat capacity of water
2. electrical power calculations
3. or radiant heat calculations

Sample Organizer for Cooking Comparison

<table>
<thead>
<tr>
<th>Type of food used:_____</th>
<th>Primary method of heat transfer</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Conduction</td>
</tr>
<tr>
<td>Method of cooking</td>
<td>Convection</td>
</tr>
<tr>
<td>Brief explanation of</td>
<td>Radiation</td>
</tr>
<tr>
<td>the cooking method</td>
<td></td>
</tr>
<tr>
<td>Quantity of food used</td>
<td></td>
</tr>
<tr>
<td>Time of cooking</td>
<td></td>
</tr>
<tr>
<td>Temperature of cooking</td>
<td></td>
</tr>
</tbody>
</table>

Sample Rubric for Evaluating Food
Rank the food

<table>
<thead>
<tr>
<th>Letter of food sample = _________________</th>
</tr>
</thead>
<tbody>
<tr>
<td>1=worst</td>
</tr>
<tr>
<td>Taste</td>
</tr>
<tr>
<td>Texture</td>
</tr>
<tr>
<td>Tenderness</td>
</tr>
<tr>
<td>Aftertaste</td>
</tr>
</tbody>
</table>