

HEAT TRANSFER THROUGH METAL PANS

Performance Standards 12C/11A/13A/13B.I

Students will apply the processes of scientific inquiry to investigate heat energy mechanics accordingly:

- *Knowledge*: understand heat mechanics as associated with chemical and physical properties of metals in different brands of cookware.
- *Application*: analyze advertising claims about properties of different cookware for scientific validity.
- *Communication*: report the scientific findings about cookware properties to evaluate advertising claims for consumers.

Procedures

1. ***In order to know and apply concepts that describe the properties of matter and energy and the interactions between them (12C); the concepts, principles and processes of scientific inquiry (11A); the accepted practices of science (13A); and concepts that describe the interaction between science, technology and society (13B)***, students should experience sufficient learning opportunities to develop the following:

- Collect statements of scientific studies and research scientific foundations used in marketing and advertising about cookware ‘superiority.’
- Design an investigation which can test and compare the heating properties of cookware.
- Determine the variables and controls for a cookware investigation.
- Incorporate safety considerations, materials/equipment handling directions and data-collection formats.
- Secure approval for all procedures, equipment uses and safety concerns.
- Collect and record temperature data, etc., accurately.
- Evaluate data sets to advertising claims.
- Interpret and represent results of investigation to produce findings.
- Report the process and results of a design investigation.
- Explain chemical and physical foundations in relation to cookware (or other heating equipment) choices in Family and Consumer Sciences settings.

Note to teacher: This activity relates to knowledge associated with Standard 12C, while addressing the Performance Descriptors for Stage I within Standards 11A, 13A and 13B. This assessment is adapted from the experiment Heat Transfer Through Metal, 4-A Food Science and You by Kay Mehas and Sharon Rodgers, 1989. Family and Consumer Sciences students will enhance their knowledge of the effect of heat transfer to the purchase of cookware and range top materials for the home or business. This also relates to topics of time management considering the time for pans to heat and the decision-making process relating to selection of cookware and ranges. This assessment applies to the National Family and Consumer Sciences Standard 2.0 (Consumer and Family Resources/Evaluate management practices related to the human, economic and environmental resources). This assessment will demonstrate Standard 2.1, management of individual and family resources, including food. This could be used as an application or assessment through Family, Career and Community Leaders of America (FCCLA) as Community Service (Resource Management Education) and/or Financial Fitness (Consumer Clout).

2. Have students review and discuss the assessment task and how the rubric will be used to evaluate their work.
3. Begin this investigation by asking students about brands of pots and pans used at home or in the classroom. Brainstorm to get a listing of the desirable properties for purchase of cookware. Also consider the differences in cookware (different metals, different gauges, different sizes, etc.). Ask student to find advertisements about cookware products or marketing labels on specific products about their ‘scientifically based’ superiority. Ask students to brainstorm ways to test the marketing claims about different cookware. A possibility for this investigation could be browning flour, cooking pancakes, melting butter (or margarine or shortening, etc.) in the different kinds of pans within certain time or temperature limits. Other ideas can be suggested by the students. Allow students to devise an investigation for comparing the heat conduction properties of the metals in different cookware. They need to consider how to test the cookware, what supplies are needed, the safety precautions for the investigation and how they can collect and record the necessary data and how they can prove or disprove advertising or marketing claims.

4. Provide each student with a copy of the student worksheet Heat Transfer through Metal Pans. Supply the students with requested materials. They will probably compare the time to brown and the hot spots in a variety of metals in cookware. After they conduct their tests, they should determine how to compare their findings since they may have different conditions, variables or processes. They will also need to determine the factors that matter the most for private and commercial consumers. Students should compare their findings to advertising claims to determine the accuracy of the claims. They should record their findings and conclusions and rationale about the ‘superiority’ of a cookware choice and the validity of cookware advertising claims generally.
5. Evaluate each student’s work using the Science Rubric as follows, and add the scores to determine the performance level:
 - *Knowledge:* Identification of different metals used in cookware and the thermodynamics of the metals is accurate.
 - *Application:* Investigate the metal thermodynamics in time for each metal to heat and any development of hot spots.
 - *Communication:* The conclusion summary was well organized, well detailed and thoroughly explained to analyze the thermodynamics of the metals.

Examples of Student Work

- [Meets](#)
- [Exceeds](#)

Time Requirements

- One class period for orientation
- One class period for testing
- One class period for analysis and discussion

Resources

- Shortening, margarine, butter, etc.
- Flour, pancake mix, etc.
- Thermometers, clock/stopwatch, etc.
- Cookware in variety of metals
- Heat Transfer Through Metal Pans Idea Page
- Science Rubric

One procedure which might be used for this assessment is:

1. Lightly grease and flour each pan.
2. Remove excess flour.
3. Place pan on medium preheated range.
4. Time the length of time it takes for the pan to become golden brown.
5. Record data.

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Idea Page

How could you design this experiment? List the steps. What safety factors do you need to consider? What materials and equipment do you need?

Metal Pan (with specific differences for size, gauge, etc.)	Time factors? (with specific start and stop points)	Appearance requirements (when to stop and measure, etc.)	Observations

Analyze your findings: Which pan(s) heated the fastest? Which pan(s) had hot spots? Which pan(s) would you use for food items that easily burn? How could this information be used in consumer or commercial settings? How do your findings compare to the advertising claims.

SCIENCE RUBRIC

Exceeds - must receive no more than one 3 and the rest 4s in the other areas of the rubric.

Meets - may receive no more than one 2 and a combination of 3s and 4s in the other areas of the rubric.

Approaches - may receive no more than one 1 and a combination of 2s, 3s or 4s, in the other areas of the rubric.

Begins - must receive at least a 1 in all 3 areas of the rubric.

	KNOWLEDGE	APPLICATION	COMMUNICATION
	Knows and understands scientific terms, facts, concepts, principles, theories and methods.	Applies scientific knowledge, skills and methods to manipulate, analyze, synthesize, create and evaluate.	Communicates scientific knowledge and applications through writing, speech and visual displays.
4	<ul style="list-style-type: none"> • Descriptions of scientific terms, facts, concepts, principles, theories and methods are complete and correct. 	<ul style="list-style-type: none"> • Applications are thorough, appropriate and accurate. 	<ul style="list-style-type: none"> • Written, oral and/or visual communication is well organized and effective.
3	<ul style="list-style-type: none"> • Descriptions of scientific terms, facts, concepts, principles, theories and methods are mostly complete and correct. 	<ul style="list-style-type: none"> • Applications are mostly thorough, appropriate and accurate. 	<ul style="list-style-type: none"> • Most of the written, oral and/or visual communication is well organized and effective.
2	<ul style="list-style-type: none"> • Descriptions of scientific terms, facts, concepts, principles, theories and methods are somewhat complete and correct. 	<ul style="list-style-type: none"> • Applications are somewhat appropriate and accurate. 	<ul style="list-style-type: none"> • Some of the written, oral and/or visual communication is organized and effective.
1	<ul style="list-style-type: none"> • Descriptions of scientific terms, facts, concepts, principles, theories and methods are minimally present or correct. 	<ul style="list-style-type: none"> • Applications are minimally appropriate and accurate. 	<ul style="list-style-type: none"> • Little of the written, oral and/or visual communication is organized and effective.
0	<ul style="list-style-type: none"> • All descriptions of scientific terms, facts, concepts, principles, theories and methods are missing and/or incorrect. 	<ul style="list-style-type: none"> • All applications are missing and/or incorrect. 	<ul style="list-style-type: none"> • All of the written, oral or visual communication is missing and/or lacks organization.
Score			