What does science have to do with ***bearings?***

GET REAL SCIENCE!

Company Background
McCain Foods is a global business that has been creating great tasting food for over 60 years! As a privately owned family company with sales in over 160 countries and a global team of 22,000 people, our values are at the heart of everything we do. Our people, product quality, and customer dedication are at the core of our business. The McCain Foods, Appleton facility makes appetizers such as mozzarella cheese sticks, jalapeno poppers, and pickle fries. This location also recycles food waste generated during production with the use of a local digester. Almost all other waste is also recycled, resulting in very minimal waste to the landfill. For more information, visit www.mccain.com.

Get Real Science Video Link: What does science have to do with bearings?

YouTube Video Link: https://youtu.be/cy0BoeLUqb4

Teacher Note
This lesson is written to accompany the above video. It is recommended that you watch the entire video in advance. This will help you to anticipate student misconceptions and questions and prepare ways to support their sense making.

If this is the first time that you are using the system models and modeling with your students, take the time to review the Next Generation Science Appendix F section on developing and using models for appropriate grade level expectations.

Lesson Summary
In this lesson students will construct a device to develop an understanding of thermal energy transfer and its wide range of applications including heat applied to bearings.

Standards Alignment
Next Generation Science Standards Performance Expectations
4-PS3-4
Make observations to provide evidence that energy can be transferred from place to place by sound, light, heat, and electric currents.

MS-PS3-3
Apply scientific principles to design, construct, and test a device that either minimizes or maximizes thermal energy.

HS-PS3-2
Develop and use models to illustrate that energy at the macroscopic scale can be accounted for as a combination of energy associated with the motions of particles (objects) and energy associated with the relative positions of particles (objects).

Science & Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Constructing Explanations & Designing Solutions	PS3.A: Definitions of Energy PS3.B: Conservation of Energy and Energy Transfer ETS1.A: Defining and Delimiting an Engineering Problem	Energy and Matter

Lab Safety: Wear safety goggles at all times when the heat source is on.

Materials

2 new glass twist off jars (example: Pickles)
Cardstock
Aluminum foil
Modeling Thermal Expansion worksheets
Tongs
Glue
Scissors
Heat source (hair dryer, hot plate)
Safety goggles
Access to hot water
Post it notes
Chart paper
Tape

Teacher background information:

Thermal expansion: the ability of a metal to expand or contract based on temperature changes.

- When a material heats up (such as the aluminum foil in this exploration), its particles move around more and spread further apart from each other. This causes a physical change in the material such as volume or shape change. The opposite happens when an object is cooled.
- The conclusion question regarding the basketball involves the same concept. When a gas is heated, its particles increase speed → move further apart → increase pressure of the object. When a gas is cooled the exact opposite happens. The gas particles decrease speed → move closer together → pressure decreases. The basketball seems flat because the cold temperature decreased the pressure of the basketball.

Procedure

Part A: Phenomena

1) Ask for a student volunteer to open a jar of pickles. If they can't open the jar or struggle at first to open, ask the students what you could do to make it easier to open the jar. Some student ideas might include hitting the jar, using towel or gloves, running the jar under hot water.
2) Ask students which ideas they might be able to test right now. Say, the variable we will be testing is to run the jar lid under hot water.
3) Run the second jar lid (or first jar if unopened) under hot water. Have the same student try to open the jar. Ask which was easier.

Part B: Driving Question Board

4) Create a driving question board. Create a title at the top of the chart paper that reads "How does heat help remove a jar lid?" Hand each student two post it notes. Have them create two questions regarding their thoughts on how heat played a role in opening the jar. Have them post their questions to the driving question board.
5) Read each question. Try to summarize any trends or recurring questions you see from students.

Part C: Investigation

To help you gain an understanding of what you'll be doing with students, watch 4:15-5:00 of this video in advance. You can also cut the paper strips out in advance to save time.

6) Students will be creating a bimetallic strip. Have students get into groups of 4. Have them obtain one sheet of cardstock and aluminum foil. Students should cut 4 strips of cardstock that measure 1 inch x 6 inch. Have students glue the cardstock to the foil, leaving enough space between each strip so that it can be cut out. Encourage students to use minimal glue spread the glue evenly on their cardstock prior to gluing it down so it dries uniformly and quickly.
7) While the glue dries, show students the following video: What does science have to do with bearings?
    a) Break 1: Ask students to brainstorm where they think bearings are used.
    b) Break 2: Ask students how they could get the bearing to fit on the shaft. What could they do to the bearing?
    c) Recap video with students: How did they get the bearing to fit? How does that relate to the pickle jar we observed at the start of class?
8) Return to the bimetallic strips. Before applying heat to the strip, students will create a model of the bimetallic strip in the "before" section (see attached worksheet).
9) Have students return to their groups of four and cut out the bimetallic strips they created. Using tongs, have students apply the heat source to the **aluminum foil** side of their strip. Add observations to the "during" section of their model worksheet.
10) Allow the strip to cool off briefly. Students should then tape one end of the strip to the table and observe. Students should write down observations in the "after" section of their worksheet.
11) Have students return to their models. Have them create a model in the "during" and "after" sections of the worksheet.
12) When the student models are complete. Have each group display their models side by side. Provide time for students to review and explore the models made by the other groups.
13) At the completion of the sharing of models, ask students to identify similarities and differences between the model that they created and those made by their classmates. Allow students time to revise their models if they wish.
14) Tell students they are going to use what they have learned so far to hopefully diagram what happened to the bearing when heated. Show the video again and ask students to pay close attention to the heating process and how the bearing fits on to the shaft after being heated.
15) As a class, create a before, during and after model. Start off by creating the "before" section with students as they may be unfamiliar with the structure of a bearing. See example below. Ask questions to co-construct the "during" and "after" sections of the model.
16) Students should complete the conclusion questions at the end of the models worksheet.

Name ______________________________________ Date _________________

Get Real Science

Models

Directions: Use this worksheet with the Get Real Science video and procedure: What Does Science have to do with Bearings?

Bimetallic Strip

Observation table

Before	
During	
After	

Model

Before | During | After

Bearings

Observation table

Before	
During	
After	

Model

Before During After

Conclusion Question

1. Billie and her friends wanted to play basketball even though it was cold outside. When she tried to bounce her basketball, she noticed it was flat even though she just added more air the day before. Her friends discussed why they thought this happened. Which friend do you agree with? Explain your answer and use a diagram to support your response.

   Michael: The ball must be frozen. That's why it doesn't bounce as well.

   Sammy: The floor is cold so it can't bounce as high.

   Fiona: The pressure inside the ball decreases in cold weather.

   Pedro: The temperature is colder so the ball gets heavier and is harder to bounce.