Lesson 3.6
Creating Digital Models of Emulsifiers
Lesson Overview

Students create digital models of emulsifiers and prepare to write an explanation of the ingredients that the class has determined make the best salad dressing and why. First, using the Modeling Matter Diagramming Tool (3.6 Emulsifier Model in Science Practice Tools), students work in pairs to create a digital nanoscale model that shows how the molecules of oil, vinegar, and lecithin mix together to create a stable salad dressing. Students describe what a model of oil and vinegar shows before lecithin is added, as well as what their digital models show. This serves as a Critical Juncture, enabling the teacher to assess students’ understanding of how different levels of attraction between molecules at the nanoscale determine whether two liquids will separate or mix. This provides the teacher with another opportunity to assess students’ understanding of attraction between molecules. Pairs then swap models and evaluate one another’s models based on how well the models represent what the class has learned. Then, the class receives a final email from the president of Good Food Production, Inc. asking students to write a scientific explanation about what ingredient to add so the salad dressing will stay mixed and why that ingredient will work. Finally, students research their salad-dressing ingredients by reading about them in Food Scientist’s Handbook. The purpose of this lesson is to enable students to refine their nanovision models of emulsifiers prior to writing a scientific explanation of emulsification in the final lesson of the unit. This also allows students to search for additional information about salad-dressing ingredients from the unit’s reference book.

Anchor Phenomenon: A salad dressing has sediments and layers.
Investigative Phenomenon: Certain substances, such as lecithin, help create stable mixtures of liquids.

Students learn:

- Scientists revise models when they get additional evidence that helps explain how something works or why something happens.
- Reference books can be used to look up specific information or answer questions.
Gathering Evidence About Ingredients

Students read sections of the reference book and record notes in preparation for writing a scientific explanation in the next lesson.

Instructional Guide

1. Project email from the president of Good Food Production, Inc. Explain that there is a new email from the president of Good Food Production, Inc. She would like an update on the food scientists’ findings about how the salad dressing will stay mixed. Have a volunteer read aloud the email.

   To: Food Science Lab
   From: Lauren Harold, President, Good Food Production, Inc.
   Subject: Salad-Dressing Development Update

   Dear Food Scientists,

   I’m writing to ask for an update on your design of our ideal salad dressing. Our lab has gathered the oil, vinegar, citric acid, and sugar that we will include in the dressing. However, we still need to know what to add so the dressing will stay mixed. Please include a detailed scientific explanation of why this ingredient will work so I can explain it to my staff.

   Sincerely,
   Lauren Harold, President
   Good Food Production, Inc.

2. Introduce the next task. Let students know that they will now gather evidence about the way that ingredients in salad dressing mix together, based on both the investigations students have been conducting and the models they have been creating during the past few lessons. Also let students know that they will add more information from Food Scientist’s Handbook. Conducting this research will help students write scientific explanations about emulsifiers in response to the president’s request.
3. **Project notebook page.** Have students turn to page 82, Evidence About Salad-Dressing Ingredients, in their notebooks. Point out the table in which they will record notes about the ingredients they have been investigating. The sources they will draw from are *Food Scientist’s Handbook* and their own investigations and models.

As you know, scientists base their explanations on evidence. Explanations are stronger if they include evidence from more than one place, or source. You have a lot of evidence about the salad-dressing ingredients from your investigations and models. *Food Scientist’s Handbook* is another source of evidence.

4. **Distribute *Food Scientist’s Handbook***. Distribute one copy of the reference book to each pair of students.

Remember that *Food Scientist’s Handbook* is a reference book. Why do we use reference books in science? (To find information about a topic that we want to know more about. To find answers to a question we are researching.)

5. **Have students turn to the Table of Contents.** Ask students which sections might be most relevant to their research about the way that salad-dressing ingredients mix together. ("Ingredients in Food Science" section: "Flavor Ingredient" sections and the "Texture Ingredient" sections. "Processes in Food Science" section: "Mixing Process: Emulsifying Salad Dressing" section.)

6. **Have students turn to the Index.** Remind students that the index in a reference book can be used to look up specific topics—in this case, specific ingredients. Suggest that another method for finding information could be to use the index to find information about vinegar, oil, and lecithin.

7. **Do a think-aloud as you record notes about oil.** Have students turn to page 38 in the reference book, the “Mixing Process: Emulsifying Salad Dressing” section. Mention that you noticed the word *oil* in the paragraph under the heading “Process.” Have a volunteer read aloud this section.

We read about what happens when our base ingredients, oil and vinegar, mix together. This idea from the *Handbook* is important: *molecules in vinegar are more attracted to themselves than they are to molecules in oil.* I will write a note about that idea, along with the page number on which I found it, in the second column of the table. Leave the third column blank for now.

8. **Pairs read and record notes.** While pairs work, circulate to help any students who might need more support in using the Table of Contents and/or the Index to find the appropriate sections of the reference book and in reading and making inferences from the text.

9. **Conclude the lesson.** Let students know that they will finish recording their notes in the third column in the next lesson.
Teacher Support

Background

Science Note: About Firsthand and Secondhand Evidence
One of the important guiding principles of this curriculum program is to involve students in connecting firsthand inquiry experiences and secondhand text-based experiences. Enabling students to make connections between experience and text motivates engaged reading, helps students develop deep understanding of science concepts, improves reading comprehension, and provides authentic opportunities for experience with informational text. By conducting secondhand research at this point in their investigations, students are engaging in authentic scientific research and are corroborating that their research aligns with what other scientists have discovered. This provides students with an opportunity to draw more sophisticated conclusions and develop more accurate conceptual understandings than they could otherwise.

Possible Responses

Investigation Notebook
Evidence About Salad-Dressing Ingredients (page 82)

Column 2 only

vinegar (or water): Vinegar molecules are more attracted to themselves than they are to molecules in oil (page 38).

oil: Oil and vinegar (or water) do not stay mixed together (page 38). Oil molecules are more attracted to themselves than they are to molecules in vinegar (page 38).

lecithin: Lecithin is an emulsifier (page 24). Added to many foods to keep them mixed (page 24). Causes oil and vinegar molecules in salad dressing to rearrange (page 38).
Evidence About Salad-Dressing Ingredients

1. Locate information about each salad-dressing ingredient in *Food Scientist’s Handbook*. In the second column, record evidence that will help you explain why the ingredients stay mixed.

2. Think about your investigations and models. In the third column, record evidence that will help you explain why the ingredients stay mixed.

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Evidence from <em>Food Scientist’s Handbook</em> (include page numbers)</th>
<th>Evidence from investigations and models</th>
</tr>
</thead>
<tbody>
<tr>
<td>vinegar (or water)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>oil</td>
<td></td>
<td></td>
</tr>
<tr>
<td>lecithin</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Gathering Evidence About Ingredients

Students read sections of the reference book and record notes in preparation for writing a scientific explanation in the next lesson.

Instructional Guide

1. **Project email from the president of Good Food Production, Inc.** Explain that there is a new email from the president of Good Food Production, Inc. She would like an update on the food scientists’ findings about how the salad dressing will stay mixed. Have a volunteer read aloud the email.

   ```
   Para: Laboratorio de Ciencia de Alimentos
   De: Lauren Harold, Presidenta, Good Food Production, Inc.
   Asunto: Actualización del desarrollo del aderezofa ensaladas
   
   Estimados científicos/as de alimentos:
   
   Les escribo para pedirles una actualización sobre su diseño de nuestro aderezo para ensaladas ideal. Nuestro laboratorio ha reunido el aceite, vinagre, ácido cítrico y azúcar que incluiremos en el aderezo. Sin embargo, aún necesitamos saber qué agregar para que el aderezo permanezca mezclado. Por favor, incluyan una explicación científica detallada sobre por qué funcionará este ingrediente, para que yo pueda explicarlo a mi equipo.
   
   Atentamente,
   Lauren Harold, Presidenta
   Good Food Production, Inc.
   ```

2. **Introduce the next task.** Let students know that they will now gather evidence about the way that ingredients in salad dressing mix together, based on both the investigations students have been conducting and the models they have been creating during the past few lessons. Also let students know that they will add more information from **Food Scientist’s Handbook**. Conducting this research will help students write scientific explanations about emulsifiers in response to the president’s request.
3. **Project notebook page.** Have students turn to page 82, Evidence About Salad-Dressing Ingredients, in their notebooks. Point out the table in which they will record notes about the ingredients they have been investigating. The sources they will draw from are *Food Scientist’s Handbook* and their own investigations and models.

Como saben, los científicos basan sus explicaciones en evidencia. Las explicaciones son más sólidas si incluyen evidencia de más de un lugar, o fuente. Ustedes tienen mucha evidencia sobre los ingredientes del aderezo para ensaladas de sus investigaciones y modelos. El *Manual de los científicos de alimentos* es otra fuente de evidencia.

4. **Distribute *Food Scientist’s Handbook*.** Distribute one copy of the reference book to each pair of students.

Recuerden que el *Manual de los científicos de alimentos* es un libro de referencia. ¿Por qué usamos libros de referencia en la ciencia? [Para encontrar información sobre un tema acerca del cual queremos saber más. Para encontrar respuestas a una pregunta que estamos investigando].

5. **Have students turn to the Table of Contents.** Ask students which sections might be most relevant to their research about the way that salad-dressing ingredients mix together. [“Ingredients in Food Science” section: “Flavor Ingredient” sections and the “Texture Ingredient” sections. “Processes in Food Science” section: “Mixing Process: Emulsifying Salad Dressing” section.]

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Leímos acerca de qué sucede cuando nuestros ingredientes básicos, el aceite y el vinagre, se mezclan. Esta idea del Manual es importante: *las moléculas en el vinagre se atraen más a sí mismas de lo que se atraen a las moléculas en el aceite*. Escribiré una nota sobre esa idea, junto con el número de página en la que la encontré, en la segunda columna de la tabla. Dejen la tercera columna en blanco por ahora.

8. **Pairs read and record notes.** While pairs work, circulate to help any students who might need more support in using the Table of Contents and/or the Index to find the appropriate sections of the reference book and in reading and making inferences from the text.

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**lecithin:** Lecithin is an emulsifier (page 24). Added to many foods to keep them mixed (page 24). Causes oil and vinegar molecules in salad dressing to rearrange (page 38).
Evidencia acerca de ingredientes para el aderezo para ensaladas

1. Localiza información sobre cada ingrediente para el aderezo para ensaladas en el *Manual de los científicos de alimentos*. En la segunda columna, apunta evidencia que te ayude a explicar por qué los ingredientes permanecen mezclados.

2. Piensa en tus investigaciones y modelos. En la tercera columna, apunta evidencia que te ayude a explicar por qué los ingredientes permanecen mezclados.

<table>
<thead>
<tr>
<th>Ingrediente</th>
<th>Evidencia del <em>Manual de los científicos de alimentos</em> (incluye números de página)</th>
<th>Evidencia de investigaciones y modelos</th>
</tr>
</thead>
<tbody>
<tr>
<td>vinagre (o agua)</td>
<td></td>
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<tr>
<td>aceite</td>
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<tr>
<td>lecitina</td>
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