From Seed to Seed:
Why do bees and plants depend on each other?

By: Nicole Brockett
Introduction
From Seed to Seed: Why do bees and plants depend on each other?

Unit introduction by Nicole Brockett

The three lessons I will modify are part of a six week unit on Heredity and Evolution through Plant Growth and Development. It is a 3rd grade Science unit. The target group is a mainstream classroom with integrated ELL students. Prior to my three lessons students will learn about planning a fair test and variables with regards to conducting controlled Science experiments.

Source of written material and lessons:
The written text is located on pages 58-59 and 70 of the Teacher’s Guide.

It is a Big Book that describes the busy life in a bee hive where queen, drone, and worker perform specific functions as contributing members of a tightly organized community


My overarching goals for the unit include:
1. I want my students to know the anatomy of the honeybee and the Brassica flower.
2. I want my students to know the interdependent relationship between bees and flowering plants.
3. I want my students to know the life cycle: “from seed to seed”.
4. I want my students to know that organisms can survive and reproduce in environments that meet their basic needs. Plants and animals have structures and behaviors that help them survive in different environments.

Common Core Standards:
RI.3.1 Ask and answer questions to demonstrate understanding of a text, referring explicitly to the text as the basis for the answers.

W.3.2 Write informative/explanatory text to examine a topic and convey ideas and information clearly.
   a. introduce a topic and group related information together; include illustrations when useful to aiding comprehension.

   b. develop the topic with facts, definitions, and details.
Lesson 1
### Lesson 1: Getting a Handle on your Bee

**Content Objectives:**
1. **Students will compare and contrast the three types of honeybees** (specifically referring to their anatomy and role within the colony).

**Guiding Discussion Questions:**
1. How are the three types of bees similar or different?
2. How does the role of the honeybee affect the colony?
3. **What would life be like if there were no more honeybees?** (Big question to think about during the three lessons)

**Language Objectives:**
1. a. **Students will discuss the similarities and differences of a honey bee in small groups.** *(Think, pair, share)*

b. **Students will work in small groups to write similarities and differences of the three types of honeybees using a graphic organizer.**

   What are the three parts of a bee?

   What are the roles of the honeybees (worker, drone, queen)?

c. **Students will share their findings from group work with the class.**

### Domain Topic

<table>
<thead>
<tr>
<th>Domain Topic</th>
<th>5</th>
<th>4</th>
<th>3</th>
<th>2</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Writing:</strong></td>
<td>Students will compare and contrast the three types of honeybees writing in complete sentences.</td>
<td>Students will compare and contrast the three types of honeybees writing in sentences.</td>
<td>Students will write in phrases using a word bank to compare and contrast the three types of honeybees.</td>
<td>Students will use a word bank to compare and contrast the three types of honeybees.</td>
<td>Students will use a fill in the blank graphic organizer to compare and contrast the three types of honeybees in pairs.</td>
</tr>
<tr>
<td><strong>Speaking:</strong></td>
<td>Students will use complete sentences to compare and contrast the three types of honeybees in a group discussion.</td>
<td>Students will use sentences to compare and contrast the three types of honeybees during the group discussion.</td>
<td>Students will use short phrases to compare and contrast the three types of honeybees during the group discussion.</td>
<td>Students will words and teacher prompting to compare and contrast the three types of honeybees in a group discussion.</td>
<td>Students will use words, gestures, or draw pictures to compare and contrast the three types of honeybees in a group discussion.</td>
</tr>
<tr>
<td>Function</td>
<td>Situation</td>
<td>Expressions</td>
<td>Grammar</td>
<td>Words</td>
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<td>--------------------------------------------</td>
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<tr>
<td>Describe and identify</td>
<td>Bees:</td>
<td>The <em>1</em> is a 2___.</td>
<td>To “be”</td>
<td>1. Worker, Drone, Queen</td>
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<td></td>
<td>Worker</td>
<td></td>
<td>“s” verbs</td>
<td>2. female, male</td>
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<td></td>
<td>Drone</td>
<td></td>
<td>“est” superlatives</td>
<td>3. largest, smallest</td>
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<tr>
<td></td>
<td>Queen</td>
<td>The <em>1</em> is the <em>3</em> bee.</td>
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<td>4. Nectar, Pollen</td>
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<td></td>
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<td>The <em>1</em> mates with the <em>1</em>.</td>
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<td>5. Siphon</td>
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<td></td>
<td></td>
<td>The <em>1</em> lays about 1,500 eggs a day.</td>
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<td>6. Bee Body Parts:</td>
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<td></td>
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<td>The <em>1</em> dies after fertilization.</td>
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<td>Head</td>
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<td></td>
<td></td>
<td>Abdomen</td>
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<td></td>
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<td>The <em>1</em> takes care of the colony.</td>
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<td>Thorax</td>
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<td></td>
<td></td>
<td>It collects <em>4</em> and <em>4</em>__.</td>
<td></td>
<td>2-Antenna (touching, tasting, hearing, smelling)</td>
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<td></td>
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<td>Eyes</td>
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<td>It uses its long tongue to <em>5</em>__.</td>
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<td>6- Legs</td>
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<td>4- Wings</td>
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</table>
Getting a Handle on your bee
Lesson One (unit 6 in the original Teacher’s Guide) by Nicole Brockett

Introduction- (Time: 10 minutes)
- Refer to the Common Core learning and language objectives for the day (see lesson 1, page 1) which are posted on the board.
- To create a shared history the teacher will use a picture of a honeybee on the ELMO. (see lesson 1, Appendix page 1)
- Ask what kind of insect is this? Students will have 5 minutes to discuss or "Think, Pair, Share" what they know honeybees. Depending on their language proficiency, students may write sentences, words, or draw pictures on the KWL chart (See lesson 1 Appendix page 2).
- Additionally, the teacher will work in a small group with English Language Learners (ELLs) and provide a graphic organizer for the next activity. (See Lesson 1 Appendix: graphic organizer pages 6-9)
- Next students will create a KWL chart as a class identifying what students know and want to learn about honeybees. To make the input more comprehensible for language learners, the teacher will incorporate picture clues and gestures when ever possible into the KWL chart.
- The KWL chart will be displayed in the class room until the completion of the unit as a reference for students throughout the lessons.
- The teacher will tell the students that while they are learning about honeybees, to think about what would happen if there were no honeybees. (Students will answer the question by the end of the unit.)

Whole class read aloud: Busy as a Bee: (Time: 10 minutes)
- Read the Big Book: Busy as a Bee by Melvin Berger. (The text itself is short and concise, so it does not need to be modified further for (ELLs). However the text should be read aloud slowly, pausing whenever possible to allow students to focus on the pictures and vocabulary words.
- The teacher will ask guiding questions while reading the text such as how many body parts do you see? What are the names of the three main body parts? head, abdomen, and thorax.
- The teacher should emphasize the three types of honeybees: worker, queen, drone and their jobs or roles in the hive.
- Additionally, the teacher will emphasize vocabulary words such as fertilization and pollen baskets pausing, and pointing to the corresponding pictures.
- Students will be given a worksheet to label the parts of a honeybee as a class. The teacher will project the worksheet on the ELMO, so students can take turns coming up and labeling the honeybee’s body parts including the abdomen, head, and thorax. The teacher will use gestures, pausing and repeating vocabulary words head, abdomen, thorax to accommodate for English Language Learners. ELL level 1 and 2 students will have a word bank.
• After students label their own worksheet it will be glued into their Science Notebooks to refer back to in future lessons.

**Small Group work: (Time: 30 minutes) Compare and Contrast the three types of honeybees:**

*Students will be given two journal questions* and a page from the Science book to read and *discuss within their group.* (Written text is located on pages 58-59 of the Teacher's Guide in the Appendix of original materials. It is also in Appendix page 5 of this lesson plan).

1. *Students will discuss the questions in groups.* (suggested time 10 minutes)  
2. *Students will collaborate and write the answers to the questions on a graphic organizer.* (suggested time 20 minutes)  
3. *Students will share their findings with the class.* (10 minutes)

The following are several modification strategies that should be used to effectively scaffold for ELL students: (See page 2 for complete Content and Language Objectives and performance indicators)

• *Students should be heterogeneously grouped* (to include native speakers and ELLs) *which will help to scaffold the discussion.*

• *The teacher will work in a small group with LAS 1 and 2 to highlight important words and key ideas from the Science text during the first few minutes of group work to ensure the text is comprehensible.*

• *Mainstream and ELL level 5 students will use a blank graphic organizer. They will speak and write in complete sentences during the group discussion to compare and contrast the similarities and differences of the three kinds of honeybees.*

• *ELL level 4 students will speak and write in sentences using a word bank on a graphic organizer during the group discussion.*

• *ELL level 3 students will speak and write in phrases using a word bank on a graphic organizer during group discussion.*

• *ELL level 1-2 students will complete a graphic organizer with fill in the blanks. They will speak and write in words and use gestures and pictures as needed. Additionally, the teacher will assist ELL level 1 students during this activity as needed.*

• *The teacher will circulate around the room during small group work. She will make sure all students are engaged and assist as needed especially with LAS 1 and 2 students.*
Class Discussion about Findings: (Time 10 minutes) (See page 2 for performance indicators). Students will use the graphic organizer they completed during group work and share their answers to the following questions orally with the class.
1. How are the three types of bees similar and/or different?
2. How does the role of the honeybee affect the colony?

- The teacher will write common findings on the whiteboard or show individual groups graphic organizers on the ELMO depending on the technology available.

Conclusion: (5 minutes)
We will conclude with a review of today’s objectives.
Lesson 1: KWL Chart
Name: ___________________________  Date: ___________________________

<table>
<thead>
<tr>
<th>What I know</th>
<th>What I want to Know</th>
<th>What I learned</th>
</tr>
</thead>
<tbody>
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</tbody>
</table>
The honeybee is a social insect that lives in a remarkably well-organized colony consisting of three kinds of bees: the queen, the drones, and the workers (the kind used in this unit). Each kind of bee has basically the same three-part body plan consisting of the head, the thorax, and the abdomen. Because each kind of bee has a different job to do, parts of their bodies have evolved in specialized ways. Below are illustrations and brief descriptions of the bees in the colony and the jobs they do.

QUEEN  Life span: 3 to 5 years

The largest occupant of the hive and the only one of her kind, the queen bee is a virtual egg factory, capable of producing about 1,500 eggs a day. Shortly after hatching, the virgin queen takes one nuptial (mating) flight and is fertilized for life by a drone, with the drone’s sperm being stored in a special sac in her body. Then the queen returns to the hive to begin laying eggs that will become either workers or drones.

DRONE  Life span: 1 or 2 seasons (spring or summer or both)

Stockier than the queen and a strong flier, the drone makes up about 10 percent of the population of the hive. His only purpose in life is to catch the queen during the nuptial flight and fertilize her. Ironically, the winner dies in the act. The rest of the drones return to the hive to be fed and cared for by the worker bees until food gets scarce in the fall. Then the workers bite off the drones’ wings and unceremoniously throw them out into the cold to die.

WORKER  Life span: 3 to 6 weeks

Smallest in size but comprising 90 percent of the hive’s population, this bee is always a sterile female. The hive could not exist without her and she literally works herself to death. At different stages in her life, she specializes in different tasks such as feeding larvae; building, cleaning, and guarding the hive; secreting wax; and controlling the hive’s temperature; and collecting nectar and pollen.

The body of the worker bee is specially adapted for collecting food. Her long strawlike tongue siphons up nectar from deep inside the flowers. The nectar is stored in a nondigesting honey stomach for transport back to the hive. The worker’s hairy body traps pollen that the bee stores in a pollen basket on its hind leg. In this manner, both the nectar and the pollen are carried back to the hive to feed the colony.
Name: ___________________________ Date: ___________________________

Getting a Handle on Your Bee: Lesson 1 Graphic Organizer (ELL 1)

**Word Box:**

<table>
<thead>
<tr>
<th>queen</th>
<th>nectar</th>
<th>drone</th>
<th>pollen basket</th>
<th>worker</th>
<th>fertilization</th>
</tr>
</thead>
<tbody>
<tr>
<td>head</td>
<td>thorax</td>
<td>abdomen</td>
<td>eggs</td>
<td>largest</td>
<td>smallest</td>
</tr>
</tbody>
</table>

1. The three main parts of a bee are ____________, ____________, and ____________.

2. The queen mates with the ____________.

3. The drone dies after ____________.

4. The ____________ lays 1,500 ____________ a day.

5. The queen is the ____________ bee.

6. The ____________ takes care of the colony.

7. She is the ____________ bee.

8. She siphons ____________ from flowers.

9. Her hairy body traps pollen in ____________.

10. The ____________ is similar to the ____________ because they both

    ____________________________________________________________________________________

    ____________________________________________________________________________________

    ____________________________________________________________________________________

    ____________________________________________________________________________________

11. The ____________ is different from the ____________ because

    ____________________________________________________________________________________

    ____________________________________________________________________________________

    ____________________________________________________________________________________

    ____________________________________________________________________________________
Lesson 1: Getting a Handle on Your Bee: Used during small group discussion with Science book handout. (LAS 2)

Questions: How are the three types of honeybees similar or different?  2. How does the role of the honeybee affect the colony?

The ______ is similar to ______ because ____________________________.

The ______ is different from ______ because ____________________________.

<table>
<thead>
<tr>
<th>Name of Honey Bee:</th>
<th>Describe Body:</th>
<th>Life Span:</th>
<th>Job:</th>
<th>Sex:</th>
</tr>
</thead>
<tbody>
<tr>
<td>worker</td>
<td>smallest</td>
<td>1-2 seasons</td>
<td>Drone</td>
<td>Male</td>
</tr>
<tr>
<td>drone</td>
<td>largest</td>
<td>3-6 weeks</td>
<td>Queen</td>
<td>Female</td>
</tr>
<tr>
<td>queen</td>
<td>3 Head, Thorax, and Abdomen</td>
<td>3-5 years</td>
<td>Fertilization Lays Eggs Colony Builds and cleans</td>
<td></td>
</tr>
<tr>
<td>worker</td>
<td>1. It is the ______ bee.</td>
<td>The ______'s lifespan is _______.</td>
<td>1. He mates with the _______.</td>
<td>It is a male.</td>
</tr>
<tr>
<td></td>
<td>2. It has ___ main body parts. The ______, ______, and ______.</td>
<td></td>
<td>2. He dies after ______.</td>
<td></td>
</tr>
<tr>
<td>Queen</td>
<td>1. It is the ______ bee.</td>
<td>The ______'s lifespan is _______.</td>
<td>1. Mates with the ______.</td>
<td>It is a ______.</td>
</tr>
<tr>
<td></td>
<td>2. It has ___ main body parts. The ______, ______, and ______.</td>
<td></td>
<td>2. ______ 1,500 ___ a day.</td>
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</tbody>
</table>
Lesson 1: Getting a Handle on Your Bee: Used during small group discussion with Science book handout. (LAS 3-4)

Name: ____________________________ Date: ____________________________

1. How are the three types of bees similar or different?  
2. How does the role of the honeybee affect the colony?

<table>
<thead>
<tr>
<th>Name of Honey Bee:</th>
<th>Describe Body:</th>
<th>Life Span:</th>
<th>Job:</th>
<th>Sex:</th>
</tr>
</thead>
<tbody>
<tr>
<td>worker</td>
<td>smallest</td>
<td>3-5 years</td>
<td>Fertilization</td>
<td>Male</td>
</tr>
<tr>
<td>drone</td>
<td>largest</td>
<td>1-2 seasons</td>
<td>Lays Eggs</td>
<td></td>
</tr>
<tr>
<td>queen</td>
<td># of Body Parts</td>
<td>3-6 weeks</td>
<td>Takes care of the colony</td>
<td>Female</td>
</tr>
</tbody>
</table>


Lesson 1: Getting a Handle on Your Bee: Used during small group discussion with Science book handout. (Mainstream & ELL 5)

Name: ______________________________ Date: ______________________________

Questions: 1. How are the three types of bees similar or different?  2. How does the role of the honeybee affect the colony?

<table>
<thead>
<tr>
<th>Name of Honey Bee:</th>
<th>Describe Body:</th>
<th>Life Span:</th>
<th>Job:</th>
<th>Sex:</th>
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<tbody>
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</tbody>
</table>
Lesson 2
Lesson 2: The Bee and Brassica: Interdependence

<table>
<thead>
<tr>
<th>Content Objectives:</th>
<th>Language Objectives:</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1. Students will learn the anatomy of the Brassica Flower through observation and reading.</strong></td>
<td><strong>1a. Students will read and discuss “The Bee and the Brassica: Interdependence” in small groups.</strong></td>
</tr>
<tr>
<td><strong>2. Students will examine the relationship between the Brassica Flower and the honeybee.</strong></td>
<td><strong>1b. Students will work in small groups to label the parts of the Brassica Flower.</strong></td>
</tr>
</tbody>
</table>

**Guiding Questions:**
1. Describe the anatomy of the Brassica Flower.
2. What attracts the honeybee to the Brassica Flower?
3. Who benefits from the relationship, the bee or the flower?
4. What would life be like if there were no more honeybees?

<table>
<thead>
<tr>
<th>Domain Topic</th>
<th>5</th>
<th>4</th>
<th>3</th>
<th>2</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Writing:</strong> Students will describe the anatomy of the Brassica Flower.</td>
<td>Students will describe the anatomy of the Brassica flower using complete sentences.</td>
<td>Students will write sentences to describe the anatomy of the Brassica flower.</td>
<td>Students will use a graphic organizer or class notes to describe the anatomy of the Brassica flower.</td>
<td>Students will use a graphic organizer with a word bank to describe the anatomy of the Brassica flower.</td>
<td>Students will use a graphic organizer with a word bank to describe the anatomy of the Brassica flower in pairs.</td>
</tr>
</tbody>
</table>

<p>| <strong>Speaking:</strong> Students will make predictions and observations about the Brassica Flower. | Students will use complete sentences to make predictions and observations about the Brassica flower through group discussion. | Students will use phrases and refer to their notes as needed to make predictions and observations about the Brassica flower during the group discussion. | Students will use words and teacher prompting to make predictions and observations about the Brassica flower in a group discussion. | Students will use words, gestures, and draw pictures to make predictions and observations about the Brassica Flower in a group discussion. |</p>
<table>
<thead>
<tr>
<th>Function</th>
<th>Situation</th>
<th>Expressions</th>
<th>Grammar</th>
<th>Words</th>
</tr>
</thead>
<tbody>
<tr>
<td>Describe and</td>
<td>Brassica</td>
<td>The __<em>1</em> is a female or male part. The (female) parts are _<strong>3</strong>. The (male) parts are <strong>2</strong>. The <strong><em>1,2,3</em> is ______ 4,5,6</strong>. There are <em>7</em> <strong>1,2,3,</strong>.</td>
<td></td>
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<tr>
<td>identify</td>
<td>Flower</td>
<td></td>
<td>To “be”</td>
<td>Stamen: Male Parts</td>
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<td>“s” verbs</td>
<td>(1) Petal</td>
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<td>Adjectives</td>
<td>(1) Anther</td>
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<td>(2) Stigma</td>
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<td>Locate &amp; label</td>
<td></td>
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<td>(2) Pollen Grains</td>
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<td>(2) Filament</td>
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<td>Write sentences</td>
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<td>Pistil: Female Parts</td>
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<td>(1) Petal</td>
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<td>(3) Style</td>
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<td>(3) Ovary</td>
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<td>Adjectives:</td>
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<td>(4) Size- (large, small)</td>
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<td></td>
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<td>(5) Shape (round, oval, dots)</td>
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<td></td>
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<td>(6) color (green, white, yellow)</td>
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<td>(7) number</td>
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</table>
Brassica Flower Observations
Lesson Two (unit 6 in the original Teacher’s Guide) by Nicole Brockett

Introduction  (Time: 10 minutes)
- Refer to the Common Core learning and language objectives for the day (see lesson 2 performance indicators) which are posted on the board.
- Adding to the KWL chart: To build on shared history and background knowledge the teacher should ask students to identify the three types of honeybees and their role in the colony from yesterday. (See lesson 1 for more information about the three types of bees. ELL students should be allowed to refer back to their notes as needed)
- Next the teacher will ask students to make two predictions: What attracts the honeybee to the Brassica flower? Who benefits the bee or the flower?
- Students will have 5 minutes to discuss or come up with a “Group Response using a white board”. Each person of the group should make a prediction using pictures, words, or sentences depending on their language proficiency. (This will allow each member of the group to participate regardless of their language proficiency.)
- During this time the teacher should also walk around and support students as needed giving special attention to ELL students LAS 1-3.
- The teacher will call on each group to add some predictions to the class prediction chart. To make the input more comprehensible for language learners, the teacher will incorporate picture clues and gestures whenever possible into the chart. The teacher will remind students to continue thinking about the Big Question: What would happen if there were no honeybees? (Students will answer the question by the end of the unit.)

Observations: (15 minutes)
- According to the Hamden Public Schools curriculum students will make observations of their Brassica Flowers. To accommodate for ELL students the teacher will place students in pairs or small groups instead of working individually. Additionally, LAS 1-3 students will be given a modified observation guide with additional picture cues and a word bank (See appendix lesson 2). The teacher should also conference with ELL students LAS 1-2 during this time to further clarify key ideas and concepts as needed. The teacher will also give the modified text for “Brassica and Bee Interdependence” to LAS 1-2 and pre-teach important vocabulary words.
• The teacher should instruct students to observe their Brassica Flower focusing on the number of pods, seeds, length of pods and any other observation they can think of. Students should also note any changes in color or texture of the plant.

**Whole class Shared Reading: “The Bee and the Brassica: Interdependence”** (Time: 25 minutes) Students will be given a short text to read and discuss in groups. (See page 70 of the Teacher’s Guide in the Appendix of original text).

• Instead of reading the text independently, **students will take turns reading the text out loud, slowly, pausing whenever possible to allow ELL students to focus on key vocabulary words. The teacher should spend extra time pointing out and repeating the names of the body parts of the Brassica flower.**

• Students will be given a worksheet to label the parts of a male and female Brassica flower in pairs or small groups. After students label their own worksheet the teacher should project the image of the Brassica flower using an ELMO. Students will take turns coming up to label its parts for the class. Then worksheet will be glued into their Science Notebooks to refer back to in future lessons. Both the written text and the worksheet have been modified for ELL students. (See appendix lesson #2) LAS 1-2 will get modified text, whereas, LAS 3-4 will get the original text with key vocabulary words underlined or highlighted. Additionally, LAS 1-2 students will get a word box to aid in labeling. LAS 3-4’s modifications include that the male and female flower is identified, but there is no word box.

**Answering questions in their Journal :** (Time 20 minutes). (See appendix lesson #2 for performance indicators).

• **Using their class notes or graphic organizer students will answer the guiding questions in their Science Journals after they discuss the questions with their partner or small group. During this time the teacher should circulate and assist as needed. The teacher may also pull ELL LAS 1-2 students into a small group for extra support. Students will answer questions in sentences, words, phrases or pictures depending on their language proficiency.**

Describe the anatomy of the Brassica Flower.
What attracts the honeybee to the Brassica Flower?
Who benefits from the relationship, the bee or the flower?

**Conclusion: (5 minutes) Prediction:** What would life be like if there were no more honeybees? Finally, the teacher should review the lesson objectives for the day.

The teacher will continue to use informal observations, questioning, group discussion and written work, as an assessment tool. These tools should be used to determine if further clarification or re-teaching is necessary, especially for ELL students.
Narrative Lesson #2

I have made several modifications to the second lesson of my instructional unit. As I stated earlier, I chose to modify the first lesson by breaking it into two lessons. Therefore, my learning objectives changed as well. The original lesson plan stated that “students will learn about the anatomy of the honeybee and Brassica flower through close observation with a magnifier and through reading”. I decided to split the lesson so that day 1 Students would learn more in depth about the honeybee and move on to the Brassica Flower day 2. Therefore my new objective is **students will learn the anatomy of the Brassica Flower through observation and reading. Additionally, students will examine the relationship between the Brassica Flower and the honeybee.**

I have included several modifications in lesson two:
During the introduction of lesson one, I started with a **KWL** chart. In the second lesson I recommended that the students add to the KWL chart to create a shared history and background knowledge. Students were also given time to think, pair, and share their knowledge about what attracts honeybees to the flowers which allowed **ELLs time to negotiate meaning. Students also made predictions about the relationship between the honeybee and the Brassica Flowers.** I incorporated the use of a **white board** so that all students would get a chance to contribute to the conversation. I then allowed time for **pre-teaching and conferencing** with ELLs prior to group work.

In next part of the lesson students were supposed to read a short text independently. I decided to change this activity so that students work in **pairs or small groups. I also provided time for the teacher to confer** with the LAS 1-2 students in small groups to highlight the important ideas. During the shared reading of the **The Bee and the Brassica: Interdependence** I made several modifications. Although the text itself is short, it was filled with vocabulary words and no pictures. Therefore, I modified it further for ELLs. Rather than simplifying the text I took some of the wording out, but kept all of the main vocabulary words and concepts the same for LAS 1-2. In the text modifications for LAS 3-4 I kept all of the original text and underlined or highlighted the important vocabulary words and key ideas. In addition, I recommended that the text be read and discussed in a group instead of independently which allows ELLs ample time for discourse and to negotiate meaning. Next, the teacher provided guiding questions while reading the text such as **Describe the anatomy of the Brassica Flower, What attracts the honeybee to the Brassica Flower, and Who benefits from the relationship, the bee or the flower?** All of these strategies help make the input more comprehensible for ELL students.
Hamden’s curriculum recommends **showing** a slide of the Brassica Flower. I modified the task so that the students label Brassica Flower both individually and as a class. Again, I find that you get more out of actually “doing” the labeling, rather than just “seeing” it. The LAS 1 and 2 students were also provided a word bank. I also made a modified observation chart for LAS 1-2 with picture clues that should be used during the observation of the Brassica Flower.

Finally, in lesson two I allotted time for small group discussion, as well as whole group discussions. LAS 1-3 ELLs would be encouraged to use gestures, words or phrases as opposed to sentences to add to the discussion which is evident in my performance indicators. I feel that all of these modifications will lead to a better understanding of the content and Science vocabulary for ELL students.
Lesson #2 Brassica Flower Observations: (LAS 1-2)

1. Describe the anatomy of the Brassica Flower. 2. Who benefits the bee or flower?

<table>
<thead>
<tr>
<th>Color Words</th>
<th>yellow, white, green, brown</th>
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<tbody>
<tr>
<td>Size</td>
<td>___ inches</td>
</tr>
<tr>
<td>Shape</td>
<td>circle, oval, round,</td>
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<tr>
<td>Other words</td>
<td>buds, seeds, petals, leaves</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Flower #</th>
<th># of petals</th>
<th>Size</th>
<th>Color</th>
<th>Other observations</th>
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</table>
Lesson #2 Brassica Flower Observations: (LAS 3-4)
1. Describe the anatomy of the Brassica Flower. 2. Who benefits the bee or flower?

<table>
<thead>
<tr>
<th>Flower #</th>
<th># of petals</th>
<th>Size</th>
<th>Color</th>
<th>Other observations</th>
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</table>
Modified Text: Bee and Brassica

The bee and Brassica depend on each other. They each take something from the other. The bee helps the plant produce seeds so that a new plant can grow. The plant gives the bee food.

The Brassica flower has both male and female parts. The anther (male part) produces pollen. (Yellow power)
The pollen travels to the stigma (female part) for pollination.

The bee is attracted to the flower’s bright color and sweet smell. The bee sucks the nectar up with its straw like tongue. Her body covered with hair, rubs against the anthers. The hairs trap the pollen. When the bee travels to the next flower pollen brushes the next flower’s stigma.

The worker bee has collected two kinds of food: nectar and pollen. The seeds will grow into new plants with flowers= life cycle of the Brassica.
The Bee and the *Brassica* Interdependence

The bee and the *Brassica* plant depend on each other to survive. Each tells something from the other, and each provides something to the other. You might say that they have a real partnership.

What is the relationship between the bee and the *Brassica* plant? The bee helps the plant produce seeds so that a whole new generation of plants can grow, and the plant provides the bee with food. It all starts with the fact that a *Brassica* flower has both male and female parts. One of the male parts, the anthers, produces pollen, which looks like fine yellow powder. This pollen must travel to one of the female parts, the stigma, in order for pollination, fertilization, and the production of new seeds to take place.

For the *Brassica* plants, it is very important that the pollen from one flower be transferred to the stigma of another flower on another plant. Cross-pollination is what you call the transfer of pollen from one flower on one plant to the stigma of another flower on another plant. The pollen helps fertilize another female part—the ovules—and they become seeds.

But how does the pollen reach the other flower so that seeds can be produced? This is where the bee comes in. The bee is attracted to the flow bright color and sweet perfume. And the flower has much to give to the bee—the two kinds of food—nectar and pollen.

Picture this: the bee is dipping her head deeply into the blossom to reach nectar deep inside. She sucks the nectar up with her straw-like tongue. As she does, her body, covered with feathery hairs, rubs up against the anthers. The hairs trap some of the pollen. When the bee flies to the next plant, some of the pollen brushes off onto the next flower’s stigma.

Now the worker bee has done several jobs at once. She has collected two kinds of food from the flower, and she has carried pollen from one plant to another so that new seeds can form. Soon these seeds will grow into new plants with flowers, completing the life cycle of the *Brassica*.
Word bank:
- Filament
- Petal
- Anther
- stigma
- stamen
- pollen grains

Word bank:
- Anther
- Ovary
- Stigma
- Petal
- Style
- Pistil
The Brassica flower

Platilia
Female

Stamen
Male

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Lesson # 2
LAS 3-4
Lesson #2
LAS 5 & Mainstream
Lesson 3
Lesson 3: Pollination

### Content Objectives:

1. Students will learn about pollination using bee sticks.
2. Students will continue to examine the interdependent relationship between bees and flowering plants.

### Guiding Questions:

1. What is the relationship between the honeybee and the Brassica Flower?
2. How does the honeybee pollinate the Brassica flower?
3. What would life be like if there were no more honeybees?

### Language Objectives:

1a. Students will work in small groups to create a bee stick.
1b. Students will work in small groups to discuss how does a honeybee pollinate the Brassica flower?
1c. Students will work in small groups to develop a written plan for pollination.

2. Students will work independently to write answers to the guiding questions in their Science journal.

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<thead>
<tr>
<th>Domain Topic</th>
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<th>4</th>
<th>3</th>
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<tbody>
<tr>
<td><strong>Writing:</strong> Students will develop a written plan for pollination.</td>
<td>Students will write a plan for pollination using complete sentences including appropriate vocabulary words.</td>
<td>Students will write a plan for pollination using sentences and some vocabulary words.</td>
<td>Students will use a graphic organizer or class notes to write a plan for pollination.</td>
<td>Students will use a graphic organizer with a word bank to write a plan for pollination.</td>
<td>Students will use a graphic organizer with a word bank or pictures to make a plan for pollination.</td>
</tr>
<tr>
<td><strong>Speaking:</strong> Students will develop a plan for pollination through group discussion.</td>
<td>Students will use complete sentences to develop a plan for pollination through group discussion.</td>
<td>Students will use sentences to develop a plan for pollination during the group discussion.</td>
<td>Students will use their notes as needed to develop a plan for pollination during the group discussion.</td>
<td>Students will use sentence starters and teacher prompting to develop a plan for pollination during group discussion.</td>
<td>Students will use words, gestures, or draw pictures to develop a plan for pollination during group discussion.</td>
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<td>Function</td>
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<td>Expressions</td>
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<td>Pollination</td>
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<td>(A)Brassica Stamen: Male Parts</td>
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<td>4 the <em>b</em> lands on another 1-3.</td>
<td>Ordinal words</td>
<td>(1) Anther</td>
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<td>4 the b rubs up against the <em>l-3</em>.</td>
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<td>(4) finally</td>
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<td>(B) Bee (worker, queen, drone)</td>
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<td>(5) Siphon</td>
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<td>(5) Nectar</td>
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<td>(5) Pollen</td>
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Pollination
Lesson Three (unit 6-7 in the original Teacher’s Guide) by Nicole Brockett

Introduction - (Time: 10 minutes)
- Refer to the Common Core learning and language objectives for the day (see lesson 3 appendix) which are posted on the board.
- **Play the Teacher**: To build on shared history and background knowledge the teacher should ask students to “play the teacher” to identify the key concepts learned so far. The teacher should guide the discussion, but allow students to do the “teaching”. Guiding questions include what are three types of honeybees and their role in the colony? Describe the anatomy of the Brassica Flower. Next students should have a quick discussion about what attracts the bee to the flower and who benefits the bee or the flower? ELL students should be allowed to refer back to their notes as needed. (See lesson 1-2 for more information)

Making a bee stick: 10 minutes
- According to the Hamden Public Schools curriculum students will make bee sticks and create a plan for pollination. **To accommodate for ELL students the teacher will place students in pairs or small groups instead of working individually.**
- The teacher will explain the directions and how to glue the bee to the stick.
- **To make the input more comprehensible for language learners, the teacher will incorporate picture clues and gestures when ever possible. Students will also use the activity sheet as guidance.** (See appendix lesson 3)
- Additionally, LAS 1-3 students will be given a modified observation guide with additional picture cues and a word bank (See appendix lesson 3). The teacher should also conference with ELL students LAS 1-2 during this time to further clarify key ideas and re-teach important vocabulary words and concepts as needed. ELL LAS 1-2 students will also use the modified text for “Brassica and bee interdependence”. (see appendix lesson 3)

Next students will create a plan for pollination. (30 minutes~ 10 minutes for discussion and 20 minutes for writing)
- Students will be instructed to **pretend they are a bee** and devise a plan to pollinate the Brassica flower. **There will be two steps, first a group discussion to allow the group time to make a detailed plan for pollination. Students will be given 10 minutes for discussion. During this time the teacher should also walk around and support students as needed giving special attention to ELL students LAS 1-3.**
- **The teacher will encourage students to use all of their materials from lessons 1-2 including their Science Journals, the labeling of the Brassica Flower anatomy, the information on the honeybees’ role in the colony, as well as prior readings to develop plan for pollination.**
- The teacher should also encourage students to think about the initial reasons a bee is attracted to the flower. *Additionally, students are expected to use proper vocabulary including the male and female Brassica anatomy. LAS 1-3 students will be encouraged to refer back to their notes and use modified text and graphic organizers. (See appendix lesson 3)*

- After 10 minutes the teacher will direct students to write their plan of pollination. Students will be given 20 minutes to complete the pollination plan. LAS 1-2 will complete a flow map as a graphic organizer.

**Pollination: (10 minutes)**

- Following their pollination plan students will pollinate the Brassica Flowers using bee sticks. *(Students should literally touch the bee stick to the flowers simulating what a bee would do- rubbing against the anthers to siphon nectar from one flower trapping pollen. Then the bee should “fly” to another plant and rub pollen on the stigma, hence pollinating the Brassica flower.)*

- During this time the teacher should stop and point out specific vocabulary words such as the Brassica Flower’s male and female anatomy and the food the bee gets from the honey. *To modify for ELL students the teacher will also point and use gestures as needed.*

**Class discussion: Finish KWl CHART from lesson 1** *(Time 10 minutes).*  
(See appendix lesson #3 for performance indicators).

- The teacher will again call on each group to “play the teacher” and add the final information to the KWl chart. To make the input more comprehensible for language learners, the teacher will also incorporate picture clues and gestures when ever possible into the chart. The teacher will remind students about the Big Question: What would happen if there were no honeybees? What does “seed to seed mean”?

**Conclusion:** (2 minutes) Finally, the teacher should review the lesson objectives for the day.

Although there is no formal written assessment for the three lessons the teacher will use informal observations, group discussions, questioning, written responses and journals as assessments.

*Mainstream and LAS 5 students should also be able to answer the following questions in complete sentences (without using class notes or graphic organizers) upon completion of the three lessons.*

1. What is the interdependent relationship between bees and flowers?
2. What does seed to seed mean?
3. What would life be like if there were no more honeybees?

* *ELL students should be allowed to use class notes, pictures, or words to answer the questions as needed depending on their language proficiency.*
Narrative Lesson #3

To obtain my two objectives: Students will learn about pollination using bee sticks and Students will continue to examine the interdependent relationship between bees and flowering plants I have included several modifications in lesson three.

During the introduction of the lesson, students “play the teacher” to add key ideas and concepts to our ongoing KWL chart. I recommended that the students add to the KWL chart to create a shared history and background knowledge as well as more opportunity for discourse. Students were also given time to think, pair, and share their knowledge about what attracts honeybees to the flowers which allowed ELLs time to negotiate meaning. Students also made predictions about the relationship between the honeybee and the Brassica Flowers and what would happen if there were no more honeybees. I incorporated the use “play the teacher”, so that all students would get a chance to contribute to the conversation. Then allowed time for pre-teaching and conferencing with ELLs prior to group work.

During the activity “Making a Bee Stick” I accommodate for ELL students by placing students in pairs or small groups instead of working individually. To make the input more comprehensible for language learners, I added the use of picture clues and gestures when ever possible. Additionally, LAS 1-3 students will be given a modified observation guide with additional picture cues and a word bank. I added time for the teacher should to conference with ELL students to further clarify key ideas and concepts as needed. ELL LAS 1-2 students were also provided with modified text for “Brassica and Bee Interdependence” to highlight key vocabulary words and ideas without simplifying the text.

The next activity of creating a Pollination plan was originally a task completed independently. However, ELL students benefit greatly from group discussion and ample time to negotiate meaning. Therefore, I included group work with visuals and graphic organizers whenever possible including the flow map with a word bank for LAS 1-4 students. Lastly, I added language objectives and a functional chart to the lesson.

Throughout my unit I modified each lesson to build background knowledge through the use of realia, visuals and group discussions. I modeled instructions and created opportunities to negotiate meaning through the use of meaningful graphic organizers and discussions. I also modified text by amplifying the information instead of simplifying as needed. I attempted to make talk comprehensible through the use of KWL charts which created a word wall with relevant vocabulary, pacing of speech, and framing main ideas through guided questions. I incorporated time for individual, group and whole class activities to encourage discourse. Finally, each lesson varies questions for ability, and allows time for the teacher to pull ELLs into small group to check for understanding.
Modified Text: Bee and Brassica

The bee and Brassica depend on each other. They each take something from the other. The bee helps the plant produce seeds so that a new plant can grow. The plant gives the bee food.

The Brassica flower has both male and female parts. The anther (male part) produces pollen. (Yellow power) The pollen travels to the stigma (female part) for pollination.

The bee is attracted to the flower’s bright color and sweet smell. The bee sucks the nectar up with its straw like tongue. Her body covered with hair, rubs against the anthers. The hairs trap the pollen. When the bee travels to the next flower pollen brushes the next flower’s stigma.

The worker bee has collected two kinds of food: nectar and pollen. The seeds will grow into new plants with flowers—life cycle of the Brassica.
The Bee and the *Brassica* Interdependence

The bee and the *Brassica* plant depend on each other to survive. Each something from the other, and each provides something to the other. You might say that they have a real partnership.

What is the relationship between the bee and the *Brassica* plant? The bee helps the plant produce seeds so that a whole new generation of plants grow, and the plant provides the bee with food. It all starts with the fact a *Brassica* flower has both male and female parts. One of the male parts, anthers, produces pollen, which looks like fine yellow powder. This pollen must travel to one of the female parts, the stigma, in order for pollination, fertilization, and the production of new seeds to take place.

For the *Brassica* plants, it is very important that the pollen from one flower be transferred to the stigma of another flower on another plant. Cross-pollination is what you call the transfer of pollen from one flower to the stigma of another flower on another plant. The pollen helps pollinate another female part—the ovules—and they become seeds.

But how does the pollen reach the other flower so that seeds can be produced? This is where the bee comes in. The bee is attracted to the flower's bright color and sweet perfume. And the flower has much to give to the bee: two kinds of food—nectar and pollen.

Picture this: the bee is dipping her head deeply into the blossom to reach nectar deep inside. She sucks the nectar up with her strawlike tongue. She does, her body, covered with feathery hairs, rubs up against the anther hairs trap some of the pollen. When the bee flies to the next plant, some of the pollen brushes off onto the next flower's stigma.

Now the worker bee has done several jobs at once. She has collected two kinds of food from the flower, and she has carried pollen from one plant to another so that new seeds can form. Soon these seeds will grow into new plants with flowers, completing the life cycle of the *Brassica*.
Flow Map: LAS 1-2  Lesson #3 Pollination
Directions: To be used to make a plan for pollination with the bee stick

Word Bank:

pollen  bee  flower  color  scent  anthers  stigmas
nectar  petal  pollinated

First the ____ is attracted to the ____ by its _______ and _________.

Next the _____ lands on the flower’s _________ to siphon______ and _________.

Then ______ from the flower gets trapped in the ______’s hairs.

After the _____ lands on another _______ and _______ rubs on the _______ and _________.

Finally the ______ is _____________ and a new __________ will grow.
Flow Map: LAS 3-4  Lesson #3 Pollination

Directions: To be used to make a plan for pollination with the bee stick

<table>
<thead>
<tr>
<th>Word Bank:</th>
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<tbody>
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<td>pollen</td>
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<td>petal</td>
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<tr>
<td>pollinated</td>
</tr>
</tbody>
</table>

First

Next

Then

After

Finally
Original Lessons
Overview

For the next two lessons, students will be focusing on pollination, the beginning of the process through which plants are fertilized. They also will be learning about the complex relationship between the worker honeybee and flowering plants. In this lesson, students learn about the physical characteristics of the honeybee. They observe real bees that have died naturally and have been dried. They attach them to sticks so that they are ready for use in pollination in the next lesson. Students also use magnifiers to observe any blossoms that might have opened.

The team members experimenting with the pollination variable will not need to make bee sticks because they will not be pollinating their plants. Instead, after making observations of the dried bees, they should read the information on pollination entitled The Bee and the Brassica: Interdependence in Lesson 7, pg. 40 of the Student Activity Book (pg. 70 of the Teacher's Guide). Then these students should devise and construct barriers to prevent accidental pollination.

Objectives

- Students learn about the anatomy of the honeybee and the Brassica flower through close observation with a magnifier and through reading.
- Students who will be pollinating follow instructions to make bee sticks.
- Students who will not be pollinating gain exposure to pollination through reading; they also devise and construct pollination prevention barriers.
- Students continue keeping daily records of their plants.

Background

Despite the many benefits derived from the work of honeybees, many of us are afraid of them or, at best, think of them as pests to be warded off before they sting. Bees do not deserve such bad press. They are vital contributors to life on earth. In addition to producing wax and honey, the bee is a major agent of pollination, the process by which pollen is transferred from the male part of one plant to the female part of another plant. This allows fertilization and seed production to take place. (For more information about pollination, see the Background in Lesson 7, pg. 65 and the Reading Selection on pg 70.)

Undoubtedly, you will discover the full range of attitudes toward bees in your class. At first, your students will express all kinds of negative reactions, and you may share some of their sentiments. This is normal.
As your students learn more about bees, a transformation will take place. The students will find it exciting to observe this otherworldly creature close up, especially now that it is harmless. The noise level will go up, but, if you listen carefully, the conversation probably will be "bee"-related.

After pollination has been introduced and the students begin to use their bee sticks as tools, they will handle the creatures quite matter-of-factly. Many will begin to take pride in how well their bee stick works. By the end of the unit, some students will ask to keep their bees!

Students may be curious about where the bees they are working with came from. They are real and died a natural death outside the hive at summer's end.

The Colony

The honeybee is a social insect that lives in a remarkably well-organized colony consisting of three kinds of bees: the queen, the drones, and the workers (the kind used in this unit). Each kind of bee has basically the same three-part body plan consisting of the head, the thorax, and the abdomen. Because each kind of bee has a different job to do, parts of their bodies have evolved in specialized ways. Below are illustrations and brief descriptions of the bees in the colony and the jobs they do. These illustrations are suitable for reproduction as an overhead transparency. The illustration on pg. 63 shows a worker bee with its body parts labeled.

**Figure 6-1**

**Three kinds of bees in a colony**

Worker  Queen  Drone

**QUEEN**  Life span: 3 to 5 years

The largest occupant of the hive and the only one of her kind, the queen bee is a virtual egg factory, capable of producing about 1,500 eggs a day. Shortly after hatching, the virgin queen takes one nuptial (mating) flight and is fertilized for life by a drone, with the drone's sperm being stored in a special sac in her body. Then the queen returns to the hive to begin laying eggs that will become either workers or drones.
DRONE  Life span: 1 or 2 seasons (spring or summer or both)

Stockier than the queen and a strong flier, the drone makes up about 10 percent of the population of the hive. His only purpose in life is to catch the queen during the nuptial flight and fertilize her. Ironically, the winner dies in the act. The rest of the drones return to the hive to be fed and cared for by the worker bees until food gets scarce in the fall. Then the workers bite off the drones’ wings and unceremoniously throw them out into the cold to die.

WORKER  Life span: 3 to 6 weeks

Smallest in size but comprising 90 percent of the hive’s population, this bee is always a sterile female. The hive could not exist without her and she literally works herself to death. At different stages in her life, she specializes in different tasks such as feeding larvae; building, cleaning, and guarding the hive; secreting wax; controlling the hive’s temperature; and collecting nectar and pollen.

The body of the worker bee is specially adapted for collecting food. Her long strawlike tongue siphons up nectar from deep inside the flowers. The nectar is stored in a nondigesting honey stomach for transport back to the hive. The worker’s hairy body traps pollen that the bee stores in a pollen basket on its hind leg. In this manner, both the nectar and the pollen are carried back to the hive to feed the colony.

Materials

For each student pollinating

1  student notebook
1  dried bee
1  toothpick
1  tray
1  hand lens
1  Activity Sheet 4, How to Make a Bee Stick

For each four-member team pollinating

1  small cup of white glue
1  paper cup

For each four-member team not pollinating

1  dried bee
1  hand lens

A variety of recycled materials from which to construct pollination prevention barriers for their experimental plants. Suggestions include large index cards, oak tag or other stiff paper, corrugated cardboard, milk cartons, and tinfoil.

Reading materials on pollination

For the class

1  overhead transparency of “The Worker Bee’s Body”
[see Appendix C, pg. 138]
Overhead projector and screen
Preparation

1. Duplicate Activity Sheet 4.
2. Place all the supplies (except the Activity Sheet) in the distribution station for each student to pick up. Remember that four to six students can be grouped to share cups.
3. Put a small dollop of glue in a cup at each work table. Place an inverted cup at each work table into which the students can poke their bee sticks after they have finished making them.
4. Obtain and set up the overhead projector and screen.

Procedure

1. Distribute Activity Sheet 4 and preview it quickly with the class. Explain that most students will be pollinating their plants during the next class (and for 5 days thereafter), so they will need to make bee sticks. Students who are experimenting with the pollination variable by not pollinating will not need to make bee sticks, but they will be expected to observe the bee.

    Students making bee sticks should follow the directions listed below:
    - Have students pick up their supplies and make a bee stick according to the directions on Activity Sheet 4. Encourage them to work independently.
    - Tell students to use their hand lenses to examine the bee's body parts. Which body parts do they think are involved in pollination?

    Note: Some bees may be damaged and may not have all their parts. Have students share if their bees are not complete.

2. Students not making bee sticks should follow the directions listed below:
   - Tell students to observe the bees with a hand lens.
   - Then they should read The Bee and the Brassica: Interdependence on pg. 40 in Lesson 7 of the Student Activity Book (pg. 70 in the Teacher’s Guide) and any other selections on pollination in supplemental books available.
   - Students should devise and construct their pollination-prevention barriers so that they will be ready as soon as the first buds open.

3. When everyone has finished, collect all of the unused supplies and return them to the distribution station. Find a place to store the bee sticks. Discard the used glue cups.

Final Activities

1. Project the overhead transparency of “The Worker Bee's Body” and allow the students time to observe it, perhaps even during cleanup.
2. Initiate an observation exercise by asking the students to describe the parts of the bee. Add that they may say what they think the part is used for.
   Use the overhead projection of the bee to help the students identify:
   - the three main body parts: head, thorax (or midsection), and abdomen
   - the two large faceted eyes and the three small eyes
- the two antennae used for touching, tasting, hearing, and smelling
- the four wings
- the six jointed legs

3. Assign the background reading on Bees, which is on pg. 35 of the Student Activity Book (pg. 57 of the Teacher's Guide).

4. Tell the students that the buds on their plants will be opening into yellow blossoms very soon. Challenge them to use the magnifier to make some observations of the buds and flowers on their own. For background information, refer them to pg. 33 in the Student Activity Book, which shows an illustration of the Brassica blossom with the parts labeled. The same picture is reproduced in Figure 6-2.

Figure 6-2

The Brassica flower
5. Remind the students experimenting with the pollination variable that they should be ready to give a brief description of their experimental plan to the class during the next lesson. They also will need to have their pollination barriers ready to put into place before the blossoms open.

6. Assign the background reading The Bee and the Brassica: Interdependence on pg. 40 in the Student Activity Book (pg. 70 in the Teacher’s Guide) for the next lesson.

7. This is an important time for students to record their observations. You could remind them to include information on the size, number, and color of the leaves and buds, as well as data about their plant’s height.

Extensions

1. Bees can be fascinating and are an excellent subject for library research; many outstanding trade books have been written about them (see the Bibliography, Appendix B, pg. 129). Here are some ideas for research:
   - A more detailed study of each of the three types of honeybees (queen, drone, and worker).
   - A more detailed study of the bee’s anatomy and how it is specialized to do a particular job. For example, how is the queen specially suited for producing eggs, the drone for mating, and, most interesting of all, the worker for its many different jobs at different stages of its life?
   - The life cycle of the bee, from egg to larva to pupa to specialized adult.
   - How the bee perceives the world—how it sees, hears, tastes, smells, and touches.
   - How bees make honey.
   - How bees communicate by dancing.
   - Why bees are important to people.

2. Much can be learned about anatomy through making models. Urge the students to make anatomically correct models of honeybees and Brassica flowers based on their research and on their own observations. Encourage them to make the models from recycled materials. If possible, see the Science and Technology for Children unit, Plant Growth and Development, Lessons 13 and 14, for ideas.

3. Challenge the students to bring in some bee-related music to play while they pollinate their plants.

4. Show a film about bees and pollination (see the Bibliography, Appendix B).

5. Weather permitting, take students on a field trip to the playground. Collect, examine, then release any insects you find there.
Figure 6-3

The bee’s body

- Antenna
- Eyes
- Legs
- Wings

- Head
- Thorax
- Abdomen
How to Make a Bee Stick

NAME: __________________________
DATE: __________________________

☐ 1. Check off each item on the supply list to be sure that you have everything you need before beginning.
   - 1 tray
   - 1 dried bee
   - 1 toothpick
   - 1 cup of glue (for table)
   - 1 hand lens
   - 1 cup (for table)

☐ 2. Observe the bee with the hand lens. Turn the bee over. Find the place where the legs are attached.

☐ 3. Put a very small drop of glue on one end of the toothpick.

☐ 4. Glue the side where the legs are to the toothpick. Make sure the head is at the end.

☐ 5. Let the glue dry for a few minutes. Be careful that the bee does not slip down the stick.

☐ 6. Now, take the time to observe the bee closely. How many of its body parts can you find? Check off each one.

   **Note:** Some bees may be damaged and not have all of their parts. Ask a classmate to share if your bee is not complete.

☐ 7. Push the bee stick into the bottom of an upside-down paper cup. There is one cup for each table. Leave the cup at your table. Your teacher will store the cups.

☐ 8. Place all the supplies neatly back on the tray in the center of your table.
Pollination and Interdependence

Overview

Under ideal conditions, from about Day 12 to Day 18, the blossoms will open, and students will use the bee sticks they made in Lesson 6 to cross-pollinate their plants. Due to delayed or slow growth, some of the experimental plants may not be ready for pollination until Day 18, 19, or later. Also, in this lesson, students who are experimenting with the pollination variable will take measures to prevent pollination from occurring.

Through readings and discussions, all students will learn more about the complexities of the interdependent relationship of the bee and the Brassica.

Objectives

- Students learn more about pollination by using their bee sticks to carry it out.
- Students experimenting with the pollination variable devise and put in place barriers to prevent pollination.
- Students learn more about the interdependent relationship between bees and flowering plants.

Background

In nature, there are many examples of interdependent relationships, where each partner is dependent on the other. For example, there is the mutually beneficial association of cattle and the cattle egret. The cattle are useful to the birds because they provide food—ticks that have a parasitic relationship with the cattle. The birds are useful to the cattle because they free the cattle from the ticks. Between bees and flowering plants, the interdependent relationship is extremely complex.

To us, the flower is a thing of beauty that delights our senses with color and perfume. But in nature, the flower serves a specialized reproductive function; it produces seeds. In the Brassica flower, the male parts (six stamens, each composed of the filament and the pollen-producing anther) encircle the female part (one pistill, composed of the stigma, the style, and the ovary). In the ovary are many ovules that become seeds, after they are fertilized. See pg. 61 for an illustration of the parts of a flower.

For Wisconsin Fast Plants™, the pollen that helps fertilize the ovules does not come from the same flower or from a flower on the same plant. The pollen comes from a flower from another Brassica plant. One Brassica plant's own pollen cannot reach its own flower's ovules—this is prevented by a chemical
reaction against the pollen. Instead, Brassica blossoms are **cross-pollinated**: they receive pollen from another plant, helping to ensure diversity among the Brassica.

For some plants, winds carry pollen from one plant to another. Brassica's yellow pollen grains are so heavy and sticky that they cannot be transported by the wind. Instead, pollen is moved from plant to plant by a remarkably well-adapted **pollen vector**, or pollinator—the worker bee.

To the worker bee, the Brassica flower represents food—nectar and pollen. Attracted to the flower by its bright color, the bee lands on a petal and thrusts her head deeply into the flower, sucking sweet nectar up through a strawlike tongue. As the bee does this, her body also brushes past the flower's **anthers**, and her hairs trap pollen. The bee also brushes against the **stigma**, which is sticky. The sticky stigma picks up pollen that was trapped in the bee's hairs from other flowers. Unwittingly, while foraging for food, the bee also has cross-pollinated the plants. The illustration on pg. 68 shows a bee pollinating a Brassica plant.

Before the bee flies back to the hive, she uses brushes on her midlegs to collect excess pollen from her head and thorax. Then she places the pollen in "pollen baskets" on her hind legs for transport back to the hive. There, the pollen is consumed by the bees, providing protein, fats, vitamins, and minerals.

The nectar gathered from the plant is stored by the bee in her **crop**, a nondigesting honey stomach. When the crop is full, the bee regurgitates the nectar in it into a storage cell in the hive. The nectar is the bee's source of carbohydrates. Through evaporation and the action of enzymes, the nectar becomes honey.

Bee and flower: each has benefited from the relationship. Each has provided the other with vital necessities. Each depends on the other to survive.

**Materials**

*For each student*

- 1 student notebook

*For every two students*

- 1 hand lens

*For each student pollinating*

- 1 bee stick (made in Lesson 6)
  - Plants with open flowers

*For each four-member team not pollinating*

  - Pollination prevention barriers (made in Lesson 6)

*For the class*

- 1 overhead transparency, "How Cross-pollination Takes Place" (see pg. 139)
- 1 overhead transparency, "Parts of the Brassica Flower" (see pg. 140)
- 1 overhead projector and screen
Preparation

1. Be sure to read the information in the Background section.
2. Set up the overhead projector and screen.

Procedure

1. Ask the nonpollinators to explain their experimental plan to the class. Have them discuss how they have kept all the variables under control. Also, students may want to show the pollination barriers they constructed to prevent accidental pollination from occurring. Suggest that they ask their classmates for comments or suggestions. Students may want to predict the outcome of this experiment. Then nonpollinators should join a teammate who is pollinating so that they can observe the process and be ready to discuss it.

2. Direct the teams that are pollinating to pick up their plants, bee sticks, and hand lenses at the distribution station. Tell them that pollination must be repeated for 5 days.

3. Tell students to cross-pollinate every blossom that is open today. This means that they must transfer pollen from the blossom on one plant to the blossom on another plant by rotating the bee gently against the anther and stigma of one flower and then against the anther and stigma of the other flower.

4. Stop the pollination process periodically and ask the students to observe with their hand lenses. Tell them to look for:
   - pollen on the anthers and on the stigmas
   - pollen trapped in the bee's hairs

5. After they have finished pollinating, students should clean up. Project the transparency, "How Cross-pollination Takes Place," on pg. 139, and allow the students to observe it for a short time, perhaps even during the cleanup period.

6. Initiate a discussion on pollination. The point of the discussion is for the students to come to the conclusion that both the bee and the blossom benefit from their relationship.

   In the discussion, ask the students what attracts the bee to the flower in real life (color and scent). Ask what the bee gets from the flower (two kinds of food: nectar and pollen). Point out that the bee must squeeze between the anthers and the stigma to reach the nectar with her strawlike tongue. Students also should have noticed the yellow pollen grains caught in the hairs of the bee’s body.

   To help the students see what the flower gets from the bee, look at the transparency, “Parts of the Brassica Flower” (also Figure 6-2, pg. 61). It shows both the male and the female parts of the flower. Point out the female parts: the pistil with the sticky stigma at the end. Then point out the male parts: the anthers on stalks called filaments. The anthers produce the pollen.

   Ask: “How does the male part (or the pollen) of one plant get to the female part (or the stigma) of another plant?” (Through the activity of bees, of course!)
Final Activities

1. Remind the students that they must pollinate every day for the next 5 school days.

2. Assign the reading selection *The Bee and the Brassica: Interdependence* on pg. 40 of the Student Activity Book. It is reproduced for you at the end of the lesson.

3. Ask the students to predict how plants might change after pollination.

   **Note:** For Your Eyes Only! Let the students discover this on their own. After pollination and fertilization, the petals will fade to white, wither, and drop off, and the pistil will elongate and swell. The pistil is now a mature ovary, or a seed pod, that contains fertilized ovules, the developing seeds.

4. Although there are no formal lessons between now and when the students harvest and thresh their crop sometime after Day 42 (a period of about three and one-half weeks), it is important that the students continue to make careful observations and to keep complete records of the growth and development of both the control and the experimental
plants during this time. It would be helpful if you could schedule the observation and recording activities for a specific time each day and give the students frequent reminders of the importance of continuing to count, measure, sketch, and write on a daily basis.

The students' record should include plant height in centimeters; number of leaves, buds, flowers, and seed pods; changes in color or texture; and the dates when important events occurred. Mention that a notation of "no change" might turn out to be just as important later as one that does indicate change.

**Extensions**

1. There are many library research possibilities on the topics of pollination and interdependence. Ask the students to find out more about:
   - other agents of pollination such as butterflies, wasps, mice, and bats
   - other interdependent relationships: the clown fish and the sea anemone, the horse mackerel and the Portuguese man-of-war jellyfish, the aphid and the ant, the plover and the crocodile, the shark and the remora fish.

2. Ask if anyone has an insect collection that he or she would like to bring in and share with the class.

Check the levels in the watering tanks and refill them, if necessary, through Day 35.

On Day 35, remove the plants from the water mat in order to allow the seeds to dry and ripen in preparation for harvesting and threshing (after Day 42).

After pollinating for the last time, tell the students to pinch off any unopened buds.
The Bee and the Brassica: Interdependence

The bee and the Brassica plant depend on each other to survive. Each takes something from the other, and each provides something to the other. You might say that they have a real partnership.

What is the relationship between the bee and the Brassica plant? The bee helps the plant produce seeds so that a whole new generation of plants can grow, and the plant provides the bee with food. It all starts with the fact that a Brassica flower has both male and female parts. One of the male parts, the anthers, produces pollen, which looks like fine yellow powder. This pollen must travel to one of the female parts, the stigma, in order for pollination, fertilization, and the production of new seeds to take place.

For the Brassica plants, it is very important that the pollen from one flower be transferred to the stigma of another flower on another plant. Cross-pollination is what you call the transfer of pollen from one flower on one plant to the stigma of another flower on another plant. The pollen then helps fertilize another female part—the ovules—and they become seeds.

But how does the pollen reach the other flower so that seeds can be produced? This is where the bee comes in. The bee is attracted to the flower’s bright color and sweet perfume. And the flower has much to give to the bee: two kinds of food—nectar and pollen.

Picture this: the bee is dipping her head deeply into the blossom to reach the nectar deep inside. She sucks the nectar up with her strawlike tongue. As she does, her body, covered with feathery hairs, rubs up against the anthers. The hairs trap some of the pollen. When the bee flies to the next plant, some of the pollen brushes off onto the next flower’s stigma.

Now the worker bee has done several jobs at once. She has collected two kinds of food from the flower, and she has carried pollen from one plant to another so that new seeds can form. Soon these seeds will grow into new plants with flowers, completing the life cycle of the Brassica.
Harvesting and Threshing the Seeds

Overview

The Wisconsin Fast Plants™ are nearing the end of their life cycle. If they were taken off the water at least 5 days ago, their seeds are now ripe, dry, and ready for harvest. After harvesting the crop and separating (threshing) the seeds, the students will be eager to make some final tallies. Most of the teams will find that the number and size of the pods and the number of seeds were affected by their experiment; there will be tangible evidence of the effect of their experiments on the life cycle of the Brassica plant.

Objectives

- Students observe that their plants have completed their life cycle, from seed to seed.
- Students observe their plants in the last stage of their lives.
- Students harvest and thresh their “crop” and collect their final data.

Background

It is reassuring to children to realize that there is a predictable order to many forms of life. Witnessing the sequential stages in the life of the Brassica is such an experience.

In this final stage of the life cycle, the plants are brown, brittle, and dry. Expect to hear comments such as, “I hate it that my plant died.” It is important to recognize that the students have become very involved with their plants. It is equally important to point out that, although these are legitimate feelings, they are feelings and not observations. Ask if this is the end: “Is the Brassica dead and gone forever?” Surely an optimistic in the group will protest: “No! Remember the seeds! You can plant the seeds and grow Brassicas again.”

This is also the moment to draw some parallels between the stages of the Brassica plant’s life and the stages of human life. The similarities are many: the seed and the fetus both develop inside a specialized structure and are nourished by the parent, both plants and humans experience an adolescent growth spurt, both develop sexual parts, both can reproduce, both eventually die.

Materials

For each student
1 student notebook
1 tray
1. Distribute materials.

2. Make copies of Activity Sheet 5. (You may want to use this sheet only as a model, and have students set up data recording sheets in their notebooks.)

Procedure

1. Have the students break into their teams, retrieve their plants, and spend a few minutes observing the plants in their dried-out condition. The students should notice changes in color and texture. Ask each team specifically to compare their control plants with their experimental plants.

2. Pose the question: “What new data could you gather from these plants today?” The students will realize that the experimental plants differ from the control plants in important ways that they have not yet recorded. These differences might include the number of pods per plant, the size of each pod, and the number of seeds per pod.

3. Distribute Activity Sheet 5 and preview it with the class or use it as a model to show the students how to set up a similar recording page in their notebooks. Then ask: “How should we collect these new data?” Accept all reasonable plans. Ensuring discussion should bring out the importance of dividing up the job and then counting carefully, double-checking the count, reporting the count honestly, and recording the results in an organized way. Be sure that everyone understands the kind of data to be collected before they begin to harvest and thresh.

4. To harvest, instruct the students either to snap the pods off with their fingers or to cut them off with scissors. To thresh the seeds, show the students how to roll each pod gently between their hands over the tray.

5. Have the students make all of the counts and measurements called for on the activity sheet. Remind them to double-check before recording a final number.

6. All of the seeds can then be placed in envelopes for storage. The envelopes should be labeled with team names, date of harvest, contents, and totals. They also should include the question the team’s experiment was trying to answer and whether their plants were “experimental” or “controls.” If you plan to keep the seeds over a period of months, store them in the refrigerator in an airtight container. These seeds will be used for the germination experiments in Lessons 12 and 13.

Final Activities

1. Ask the students to discuss this topic: “Did the new data help answer your experimental question? How? Is it convincing evidence? Why or why not?”

2. Encourage the students to begin reviewing all of their data. They should now begin to plan how to organize it and to interpret what it means.
You probably will want to do a partial cleanup after this lesson.

Be sure to remember to store the seeds if you plan to do the germination experiments (Lessons 12 and 13).

Reserve at least four quads with potting mix, wicks, and fertilizer pellets if you plan to conduct the tropism experiments (Lessons 14 and 15). The remainder of the quads can be emptied and put away.

Leave the lighting system and at least one water tank in place for the tropism experiments.

1. Wisconsin Fast Plants™ seeds do not require a dormancy period; that is, they can be planted immediately after harvesting. Challenge the students to think of new experiments that they might conduct using their seeds.

2. If you decide to conduct germination experiments in Lessons 12 and 13, tell the students that they will be able to use their own seeds. Encourage the students to do some research on germination in preparation for these new experiments.
### Data Record: Seeds and Pods

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The Honeybee

Look at the insect in this picture. What kind of insect do you think it is? If you answered “a bee” you are correct. But there are many different types of bees. This one is named a honeybee because it makes honey from the nectar of flowers.

• How would you describe this honeybee?
• How many different body parts do you see?
Bees Use Baskets

Bees store the pollen on their back legs—in baskets! The baskets are called pollen baskets. Bees use the long hairs on their back legs to brush the grains of pollen into these baskets. The bees then take the pollen back to the hive to store it in the honeycomb cells. The pollen is used as food for baby bees.

• Can you see the bee’s pollen basket in this picture?
Checklists
Unit: From Seed to Seed: Why do bees and plants depend on each other?
Grammar and Function Checklists

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<tr>
<td>I. A. Build and Activate Background Knowledge: KWL chart</td>
<td>✓</td>
</tr>
<tr>
<td>I.B. Develop Vocabulary: Discussions, labeling, graphic organizers, use of visuals with ELMO projector</td>
<td>✓</td>
</tr>
<tr>
<td>I. C. Use extensive Visuals, Realia, Manipulatives, &amp; Gestures: Bee picture, use of ELMO</td>
<td>✓ bee picture</td>
</tr>
<tr>
<td>I. D. Model (Instructions, Processes) evident in all lessons</td>
<td>✓</td>
</tr>
<tr>
<td>I. E. Create Opportunities To Negotiate Meaning group &amp; class discussions, use of graphic organizers, teacher circulation</td>
<td>✓</td>
</tr>
<tr>
<td>II.  Make Text Comprehensible</td>
<td></td>
</tr>
<tr>
<td>II.A. Intentional Use of Graphic Organizers</td>
<td>✓</td>
</tr>
<tr>
<td>II.B. Modify Written Text</td>
<td></td>
</tr>
<tr>
<td>II.C. Amplify Number of Activities per Text</td>
<td></td>
</tr>
<tr>
<td>III. Make Talk Comprehensible</td>
<td></td>
</tr>
<tr>
<td>III.A. Pace Teacher’s Speech</td>
<td>✓</td>
</tr>
<tr>
<td>III.B. Use of Listening Guides</td>
<td></td>
</tr>
<tr>
<td>III.C. Use of Word Walls KWL chart, ELMO</td>
<td>✓</td>
</tr>
<tr>
<td>III.D. Frame Main Ideas Guiding questions, journals, discussions</td>
<td>✓</td>
</tr>
<tr>
<td>III.E.. Check for Understanding teacher questioning, informal observations of discussions and written work</td>
<td>✓</td>
</tr>
<tr>
<td>IV. Change Traditional Classroom Talk</td>
<td></td>
</tr>
<tr>
<td>IV.A. Use Teacher Question and Response Strategies</td>
<td>✓</td>
</tr>
<tr>
<td>IV.B. Practice Instructional Conversations</td>
<td>✓</td>
</tr>
<tr>
<td>V. Engage at Appropriate Language Proficiency Levels</td>
<td></td>
</tr>
<tr>
<td>V.A. Vary Question Techniques based on Student’s Language Proficiency level-- in conversations, activities, and assessments See performance indicators and graphic organizers</td>
<td>✓</td>
</tr>
<tr>
<td>VI. Give Students Voice</td>
<td></td>
</tr>
<tr>
<td>VI. A. Challenge students to produce extended academic talk Performance indicators during group discussions</td>
<td>✓</td>
</tr>
<tr>
<td>VI. B. Model Language for Oral and Written Production</td>
<td>✓</td>
</tr>
<tr>
<td>VI. C Use Group/Pr. Work to Elicit Student Talk; Students as Researchers</td>
<td>✓</td>
</tr>
<tr>
<td>VI. D. Respond to Student’s Voice – Writing and Error Correction</td>
<td></td>
</tr>
</tbody>
</table>