Bill Nye the Science Guy

Cells

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Implementation Guide

Welcome to Disney’s Bill Nye DVD collection! With the help of this Guide you can bring instructional DVDs into your science curriculum.

What’s on the DVD?

Bill Nye DVDs expand the educational features of Bill Nye the Science Guy programs. Each DVD provides students with science content through video clips aligned with National Science Education Standards (NSES) and a host of other resources.

Short video clips aligned with the NSES provide a unique opportunity for you to enhance your lessons using DVD technology. Now you can show a video clip, or even short segments of a clip, on command. But there are a host of other features, too! See the chart below for a summary.

From the **Main** menu, there are three chief sections:

<table>
<thead>
<tr>
<th>Feature</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Watch Program Menu</td>
<td>From this menu, you can play the program straight through or use the clips to customize your viewing.</td>
</tr>
<tr>
<td>Teacher Support</td>
<td>From this menu, you can access this Teacher’s Guide, the Glossary, Internet Links, and the Quiz.</td>
</tr>
<tr>
<td>Bonus Materials</td>
<td>Use this menu to try a different discussion starter, download a special screen-saver, or check out never-before-seen footage.</td>
</tr>
</tbody>
</table>

From the **Watch Program** menu, you can:

<table>
<thead>
<tr>
<th>Feature</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Play Program</td>
<td>Play the entire program from start to finish.</td>
</tr>
<tr>
<td>Bilingual Mode</td>
<td>View the entire program or clips in English or Spanish.</td>
</tr>
<tr>
<td>Glossary Mode</td>
<td>Make links to Glossary terms appear during the program.</td>
</tr>
<tr>
<td>Program Overview</td>
<td>View the program introduction, in which Bill discusses the topic covered.</td>
</tr>
<tr>
<td>Try This</td>
<td>Show students demonstrating science concepts.</td>
</tr>
<tr>
<td>Way Cool Scientist</td>
<td>Meet a real scientist who talks about his or her area of study.</td>
</tr>
<tr>
<td>Bill’s Demonstration</td>
<td>Look at a science demonstration conducted by Bill Nye.</td>
</tr>
<tr>
<td>Music Video</td>
<td>Enjoy a short music video that summarizes the topic in an age-appropriate and entertaining manner.</td>
</tr>
<tr>
<td>Science Standards</td>
<td>Take advantage of short video clips from the program, which are aligned with National Science Education Standards.</td>
</tr>
</tbody>
</table>
From the **Teacher Support** menu, you can:

<table>
<thead>
<tr>
<th>Feature</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Science Quiz</td>
<td>Give students a quiz to take independently or as a class. Seven to ten quiz items are aligned with the National Science Education Standards. The items are in multiple-choice or true-false format. Each wrong answer links to a standards-aligned video clip. At the end of the quiz, a scoring function reveals the number of correct initial answers.</td>
</tr>
<tr>
<td>Glossary</td>
<td>Check out definitions of key terms and view video clips that reinforce the concepts.</td>
</tr>
<tr>
<td>DVD Features</td>
<td>View a quick overview of the features found on the DVD.</td>
</tr>
<tr>
<td>Teacher’s Guide</td>
<td>Print out or view this comprehensive Teacher’s Guide in PDF format.</td>
</tr>
<tr>
<td>Internet Link</td>
<td>Link to the Bill Nye area of Disney’s Edustation Web site, where you can find links to Internet sites related to the content of each Bill Nye program.</td>
</tr>
</tbody>
</table>

From the **Bonus Materials** menu, you can:

<table>
<thead>
<tr>
<th>Feature</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bonus Material</td>
<td>Find out what <em>wasn’t</em> in the episode! In most cases, there’s more of the Way Cool Scientist interview, Bill Nye outtakes, and an extra discussion starter.</td>
</tr>
<tr>
<td>Additional Clips</td>
<td>See trailers of related DVDs and videos.</td>
</tr>
<tr>
<td>Screen-Saver</td>
<td>Download this cool screen-saver for your computer.</td>
</tr>
</tbody>
</table>

**The Planning Process**

This Guide provides a Lesson Planning Worksheet (see page 12), which can assist you in setting up your instruction around a topic. The following sections of this Implementation Guide are offered to assist your planning process:

- Determining Objectives and Linking to Standards
- The Learning Cycle
  - Explore
  - Apply
  - Extend
  - Assess
Determining Objectives and Linking to Standards

1. The NSES Teaching Standard A states that science teachers must “select science content and adapt and design curricula to meet the interest, knowledge, understanding, abilities, and experience of students.”

The NSES recommends that teachers “integrate . . . a practical structure for the sequence of activities, and the content to be learned.” The primary instructional model recommended by the NSES is inquiry into authentic student-generated questions about natural or designed phenomena. Since most state and local standards documents were derived from the NSES, you will find that your local and state standards match closely with content standards in the Bill Nye DVD.

Each DVD contains a menu of clips that are aligned with the NSES. You can review the standards and their aligned clips in the Science Standards menu under Watch Program. Also, the Standards listed on page 10 of this Guide allow you to look at additional NSES content standards that are addressed on the video. Here’s an example of the content standards and clips aligned with the Bill Nye DVD entitled Blood and Circulation:

**Life Science Standards (NSES) Addressed in Blood and Circulation**

Life Science: Structure and function in living systems

- Living systems at all levels of organization demonstrate the complementary nature of structure and function.
  
  Aligned clips:
  - 1 Blood vessels
  - 2 Heart pump and bloodstream
  - 3 Heart valves and blood circulation
  - 4 White blood cells
  - 5 Capillaries

- The human organism has systems for digestion, respiration, reproduction, circulation, excretion, movement, control, and coordination, and for protection.
  
  Aligned clips:
  - 6 Heart pump
  - 7 Heart muscle
  - 8 Pumping blood to brain
2. Determine your objectives for the lesson and how these objectives address the standards.

**Sample Objectives for Blood and Circulation**

In this activity students will:

- Observe and describe a body system responsible for supply and transport.
- Use this information to define a body system.
- Ask questions about the circulatory system.
- Explain how structure complements function in organs of the circulatory system.
- Cite examples of current research related to this system.

3. Design a learning cycle of instructional experiences and assessments for the students to engage in that will help students meet these standards. Students may be given teacher-planned investigations or may be guided to design their own investigations.

**The Learning Cycle**

The learning cycle is a sequence of activities that involve students in the learning process. The sequence found here is based on research from Lawson, Abraham, and Renner published in 1989. That has been adapted to include: Explore, Apply, Extend and Assess:

- **Explore**: Involves assessing students’ prior knowledge and providing opportunities for students to interact with content from the video.
- **Apply**: Includes having students use the content learned during the Explore section in a new way that is meaningful to future learning.
- **Extend**: Allows students to conduct further research around an area of interest within the topic.
- **Assess**: Provides strategies meant to inform students and teachers about the content and processes that have been learned.

**Explore**

The NSES Teaching Standard B states: “Teachers of science guide and facilitate learning.” This standard addresses the constant need to balance your predetermined goals with allowing students to set and meet their own learning goals.

*Focus and Support Inquiries*: Support student inquiries by making decisions about “when to provide information” and “when to connect students with other sources.” Knowing the best time to intervene is often determined by allowing students to ask questions and to explore concepts openly.
The NSES Teaching Standard C states: “Teachers of science engage in ongoing assessment of their teaching and of student learning.”

*Assess in Order to Guide Teaching:* The Program Overview or the Discussion Starter on the DVD can be used to gauge students’ prior knowledge. You can use student responses to make decisions about appropriate instruction and adaptations in order to meet the needs of individual students. Assessment can be in the form of student reflections from standards-aligned video clips or answers to questions found on the science quiz. Or, as in the following example, a simple graphic organizer can facilitate a formative assessment.

**Example: T-Chart from Blood and Circulation**

1. Ask students to fill out the “Know-New” T-Chart (see page 14). Have them list what they already know about the circulatory system (heart, blood vessels, blood, etc.) on the left side of their charts.

2. Show the Program Overview for Blood and Circulation. On the right side of the chart, have students list new things they have learned from watching the clip. Walk around the room and assist students in filling in their T-Charts. Replay the program as necessary to allow students to review sections of interest.

3. Once students have completed their charts, ask them to share what they have listed in the “New” column. Write these on the board. Have students write their own working definitions of the circulatory system. Once students have completed their definitions, collect and review their work to assess prior knowledge.

Conduct direct vocabulary instruction in the Explore phase. Research suggests that:

- Students must encounter words in context more than once to learn them.
- Instruction in new words enhances learning those words in context.
- One of the best ways to learn a new word is to associate an image with it.
- Direct vocabulary instruction on words that are critical to new content produces the most powerful learning.

Use the DVD Glossary with the linked video clips to expose students to new vocabulary words in context, along with associated video images. You can also find a printed version of the glossary terms in this Guide on page 16.
Example: Using the Glossary for Direct Vocabulary Instruction

*Blood and Circulation*

1. Present students with a brief explanation or description of the new term or phrase from the glossary. For example: “Capillary: A small blood vessel that connects arteries and veins.”
2. Present students with a nonlinguistic representation of the new term or phrase. Show the video clip associated with the term “capillary.”
3. Ask students to generate their own verbal description of “capillary.”
4. Ask students to create their own nonlinguistic representation of “capillary.”
5. Periodically ask students to review the accuracy of their explanations and representations. This can be done after the Apply activities.

**Apply**

Based on the information you gained from the Explore assessments, design appropriate activities for your students. Check the experiments listed in the Episode Guide (see page 11) for explanations of the demonstrations from the Bill Nye program as well as for additional experiments designed to help apply the knowledge gained.

In the following example from *Blood and Circulation*, the standards-based video clips provide background information, and an experiment from the Guide helps students apply what they have learned about arteries and veins.

---

**Example: The Structure and Function of Arteries and Veins**

1. Have students begin “Know-New” T-Charts, focusing on what they already know about the structure and function of blood vessels, arteries, and veins.
2. Watch the following chapters from the Bill Nye DVD *Blood and Circulation*:
   - Blood vessels
   - Heart pump and bloodstream
   - Capillaries
3. Complete the “Know-New” T-Charts.
4. Give students copies of the Student Recording Sheet (see page 15) and have them fill the sheets out as they conduct their experiments.
5. Do the experiment entitled “Pump it Up!” from the *Blood and Circulation* Episode Guide, in which students observe the apparent effects of pressure on arteries and veins.
6. Write down any remaining questions about the structure and function of blood vessels, arteries, and veins.
Extend

The NSES Teaching Standard D states: “Teachers of science design and manage learning environments that provide students with the time, space, and resources needed for learning science.” School administrators, parents, and the community can assist teachers in providing local resources that make science lessons pertinent and meaningful.

Identify and Use Resources Outside of the School: “The school science program must extend beyond the walls of the school.” Each Bill Nye DVD contains resources designed to facilitate such understanding, including:

- **Way Cool Scientist**, found in both Watch Program and Bonus Materials, in which scientists discuss their current areas of study. This real-world connection often results in a deeper student understanding of a particular career.

- Disney’s Edustation Web site, where relevant Internet links provide a starting point for students to further explore science topics.

- Try these video clips, with activities parents and students can do at home. The questions generated by students from these experiences can be used as foundations from which they may conduct their own research.

- Standards-aligned video clips and Bill’s demonstration video clips, which can help generate topics for further research. After viewing the clips, have students list their questions, perhaps about the most current developments in a topic. By conducting online or library research, students will find answers to their questions and will learn about a topic in greater depth.

Example: Conducting Student Research Using Blood and Circulation

Ask students to choose one of the questions they had after completing the activities from *Blood and Circulation*. An example of a student research question might be, “How has the technology related to artificial hearts advanced in the last ten years?” Explain to students that they will be conducting research to find answers to their questions. Some students may want to complete online or library research, others may want to ask an expert in the field, while others may want to design and conduct a scientific investigation. Encourage students to write a detailed procedure for finding answers to their questions. Ask students to find one or more examples of current research dealing with the circulatory system that is related to their question. **Note:** Students with similar questions may work together to complete the assignment.
Assess

Once students have conducted the research, you may choose to assess them in a number of different ways:

■ By having students write about what they learned in a journal.
■ By having students submit projects or reports.
■ By having students take the program quiz to gauge their understanding of certain facts in the video. You can either print the quiz (found in this Guide on page 18) and have each student complete it individually or use the DVD screen version and the scoring feature for whole-class assessment.
■ By designing other standards-aligned questions to augment those that are provided.

While the quiz will provide you with information about what the students have learned, it does not assess how students have processed the information. Below you will find assessment ideas that can be used to measure both content and process.

A Sample Assessment for Blood and Circulation

1. Explain to students that an important aspect of scientific inquiry is to communicate findings to others. In this assessment, students will present the following information to their peers:
   ■ The question they investigated.
   ■ The method that was used to find answers to their question.
   ■ Problems or successes during the search.
   ■ Answers to their question.
   ■ Current research related to their question.
   ■ New questions that have arisen.

2. Distribute the rubric found in the Lesson Planning Worksheet (see page 13) to students so they know how they will be assessed. Make sure students understand the criteria found in the rubric. Before you begin, you may want to allow students to make changes to the rubric so that it is clearer or makes more sense from their perspectives.

3. Allow students time to gather information to answer their questions and to prepare for their presentations. As students conduct this work, walk around the room and ask questions to assess their progress and provide input as needed.

4. Take a few minutes to clarify the rules of the presentation with the students. You may want to have multiple copies of the rubric available so that peers can rate the presentations.

5. As presentations are made, assess the quality of the student’s work as thoroughly and as equitably as you possibly can.

Congratulations! You have now completed the steps to set up a lesson plan using the Lesson Planning Worksheet. You have also explored many of the features of the Bill Nye DVD as well as the supplemental information found in this Teacher’s Guide. And most important, you’ve made significant strides toward incorporating DVD technology into your day-to-day instruction.
Science as Inquiry

Abilities necessary to do scientific inquiry

■ Identify questions that can be answered through scientific investigations.
■ Design and conduct a scientific investigation.
■ Use appropriate tools and techniques to gather, analyze, and interpret data.

Understandings about scientific inquiry

■ Different kinds of questions suggest different kinds of scientific investigations. Some investigations involve observing and describing objects, organisms, or events; some involve collecting specimens; some involve experiments; some involve seeking more information; some involve discovery of new objects and phenomena; and some involve making models.
■ Technology used to gather data enhances accuracy and allows scientists to analyze and quantify results of investigations.

Life Science

Structure and function in living systems

■ Living systems at all levels of organization demonstrate the complementary nature of structure and function. Important levels of organization for structure and function include cells, organs, tissues, organ systems, whole organisms, and ecosystems.
■ All organisms are composed of cells—the fundamental unit of life. Most organisms are single cells; other organisms, including humans, are multicellular.
■ Cells carry on the many functions needed to sustain life. They grow and divide, thereby producing more cells. This requires that they take in nutrients, which they use to provide energy for the work that cells do and to make the materials that a cell or an organism needs.
■ Specialized cells perform specialized functions in multicellular organisms. Groups of specialized cells cooperate to form a tissue, such as a muscle. Different tissues are in turn grouped together to form larger functional units, called organs. Each type of cell, tissue, and organ has a distinct structure and set of functions that serve the organism as a whole.
■ The human organism has systems for digestion, respiration, reproduction, circulation, excretion, movement, control, and coordination, and for protection from disease. These systems interact with one another.

Reproduction and heredity

■ In many species, including humans, females produce eggs and males produce sperm. Plants also reproduce sexually—the egg and sperm are
produced in the flowers of flowering plants. An egg and sperm unite to begin development of a new individual. That new individual receives genetic information from its mother (via the egg) and its father (via the sperm). Sexually produced offspring never are identical to either of their parents.

- Every organism requires a set of instructions for specifying its traits. Heredity is the passage of these instructions from one generation to another.

- Hereditary information is contained in genes, located in the chromosomes of each cell. Each gene carries a single unit of information. An inherited trait of an individual can be determined by one or by many genes, and a single gene can influence more than one trait. A human cell contains many thousands of different genes.

- The characteristics of an organism can be described in terms of a combination of traits. Some traits are inherited and others result from interactions with the environment.

**History and Nature of Science**

**Science as a human endeavor**

- Women and men of various social and ethnic backgrounds—and with diverse interests, talents, qualities, and motivations—engage in the activities of science, engineering, and related fields such as the health professions. Some scientists work in teams, and some work alone, but all communicate extensively with others.
Episode Guide

Cells

Nifty Questions in This Episode

<table>
<thead>
<tr>
<th>Question</th>
<th>Awesome Answers</th>
</tr>
</thead>
<tbody>
<tr>
<td>What are cells?</td>
<td>Cells are tiny compartments of life that make up all living things.</td>
</tr>
<tr>
<td>How many cells are there in the average human?</td>
<td>There are 100 trillion cells in the average human body.</td>
</tr>
<tr>
<td>How do our bodies grow?</td>
<td>Our bodies grow when more cells are produced than actually die.</td>
</tr>
<tr>
<td>What is the job of the nucleus?</td>
<td>The cell’s nucleus controls all its actions.</td>
</tr>
</tbody>
</table>

Experiments shown on the video:

COTTON SEEDS

**Objective:** To sprout different seeds.

- Fill a bowl half full with cotton balls.
- Place ten each of the following seeds inside the cotton balls in the bowl: sunflower seeds; bird seeds; lima bean seeds (any dry seed may be substituted).
- Pour enough water into the bowl to moisten (not drown) the seeds.
- A few days later, the seeds will have sprouted living extensions.

More interesting stuff to do:

PART 1: FOUR CELLS TO GO!

**Objective:** To make a cell model, including the membrane, cytoplasm, and nucleus.

- Stir a packet of gelatin into 1 cup of boiling water.
- Add 1/2 cup of cool water and 1 teaspoon each of starch and perfume; mix.
- Divide this mixture equally into four plastic bags (check for leaks); place a bead or small marble in each bag.
- Squeeze all the air out of the bag; twist the top of the bag and tie it with a twist wrap or piece of string.
- Let the gelatin cool and harden overnight.
- The plastic bag is the cell membrane, the gelatin is the cytoplasm, and the bead is the nucleus of each cell model.

PART 2: SLIP AND SLIDE THROUGH CELLS!

**Objective:** To illustrate diffusion.

- Fill a large bowl or beaker 3/4 full with warm water.
- Add iodine solution to the water to turn the water light brown.
- Place one cell bag from the Four Cells To Go experiment into the iodine and water solution.
- Some of the iodine solution will enter the “cell” through the bag membrane and turn the starch in the bag blue, then black.
- The iodine solution in the bowl stays the original light brown color. Only substances that dissolve can pass through membranes; this process is called “diffusion.”
- EXTRA! EXTRA! Try This!
- Place another cell bag in a bowl of clear water.
- After 3 hours, smell the water in the bowl.
- Does it smell like the perfume used in the bag? (Perfume can dissolve in solution).
- Try other experiments using the cell bags (food coloring and water, etc.).
<table>
<thead>
<tr>
<th>Lesson Title</th>
<th>National Science Educational Standards</th>
</tr>
</thead>
<tbody>
<tr>
<td>Objectives</td>
<td></td>
</tr>
<tr>
<td>Estimated Time Required</td>
<td></td>
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<tr>
<td>Materials Needed</td>
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<tr>
<td>Explore</td>
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<td>Apply</td>
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<td>Extend</td>
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</tbody>
</table>
As presentations are made, assess the quality of the student's work as thoroughly and as equitably as you possibly can. The following criteria can be used to assist in your assessment.

**Name of Student**

**Question Investigated**

<table>
<thead>
<tr>
<th>Initial Question</th>
<th>Methods for Finding Answers</th>
<th>Results</th>
<th>Communication</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Question is broad and not well defined</td>
<td>1 Students do not share planned or actual methods.</td>
<td>1 Student results are undefined.</td>
<td>1 Student is not prepared to speak.</td>
</tr>
<tr>
<td>2 Question is defined but limited to single-answer responses.</td>
<td>2 Students share methods but they are unclear or vague.</td>
<td>2 Student results are incomplete and do not adequately answer the question.</td>
<td>2 Presenter has distracting mannerisms and avoids eye contact with the audience.</td>
</tr>
<tr>
<td>3 Question is clear and might elicit multiple responses that may lead to new ideas and additional questions.</td>
<td>3 Students share methods but not the problems or successes of using the methods.</td>
<td>3 Student results are complete, adequately answer the question, and include current research related to the question.</td>
<td>3 Presentation is clean and clear with some eye contact and very few distractions.</td>
</tr>
<tr>
<td>4 Question is engaging and provokes new ways of thinking about an issue.</td>
<td>4 Students share methods and problems or successes in using the methods.</td>
<td>4 Student results are complete, include current research, and have resulted in one or more additional questions.</td>
<td>4 Presentation is exceptional and unique. Presenter uses regular eye contact and avoids distractions.</td>
</tr>
</tbody>
</table>
# Bill Nye the Science Guy

## Student “Know / New” Chart

<table>
<thead>
<tr>
<th>Know</th>
<th>New</th>
</tr>
</thead>
<tbody>
<tr>
<td>Write down what you know about the topic of the video.</td>
<td>Write down information from the video that is new to you.</td>
</tr>
</tbody>
</table>
Bill Nye the Science Guy

Student Recording Sheet

Name ___________________________________________ Date ____________

Title of Experiment ________________________________________________

Question: (What are you testing?) ____________________________________

____________________________________________________________________

Procedure: (Describe the experiment) _________________________________

____________________________________________________________________

Materials: (List what you used) _______________________________________

____________________________________________________________________

Observations: (Record what happened) _________________________________

____________________________________________________________________

Results: (Make your own data table)

____________________________________________________________________

Conclusions: (Use your observations and results to describe what you learned)

____________________________________________________________________

____________________________________________________________________

____________________________________________________________________
<table>
<thead>
<tr>
<th>Glossary</th>
<th>Cells</th>
</tr>
</thead>
</table>
| **NUCLEUS** | Nucleus  
The cell part that controls the metabolism, growth, and reproduction of the cell. |
| **MITOCHONDRIA** | Mitochondria  
The organelle of the cell that provides the energy for the cell. |
| **CELL MEMBRANE** | Cell membrane  
The cell part that surrounds the cytoplasm and other structures in animal cells. Through osmosis, it allows nutrients in and waste out. |
| **CELL WALL** | Cell wall  
The cell part that surrounds the cell membrane and cytoplasm and other structures in plant cells. It provides support to the plant cell. |
**METAMORPHOSIS**

Metamorphosis
A change in form, structure or substance; the change of an animal from larva to pupa to adult form.

**GENES**

Genes
The cell parts, made of DNA, that determine the cell’s characteristics.

**DNA**

DNA
Deoxyribonucleic acid, the double helical structure that carries genetic information.

**OSMOSIS**

Osmosis
The movement of substances through a semi-permeable membrane.
True or False? Circle T or F

1. An organism’s tissues and organs are made of cells. T or F
2. The cells in your body are the same cells that you were born with. T or F
3. Plant and animal cells are exactly alike. T or F
4. All plants and animals have the same number of chromosomes. T or F
5. Red blood cells transport oxygen, and white blood cells fight infection. T or F
6. Skin cells are the fastest growing type of cells in the human organism. T or F
7. Cell membranes are so solid that they keep everything from going into and out of cells. T or F

Multiple Choice: Circle the letter of the best answer

8. Which of the following is not covered by skin?
   A. Bones
   B. Intestines
   C. Mouth
   D. Stomach

9. Which of the following statements correctly describes the function of cell parts?
   A. The cell membrane determines which type of cell will develop.
   B. The nucleus contains all the nutrients that the cell needs.
   C. The mitochondria are the power plants of the cell.
   D. The genes contain hemoglobin.

10. Which of the following statements correctly describes what happens at the cellular level when an organism grows?
    A. Cell reproduction takes place more slowly than cell death.
    B. Cell reproduction occurs faster than cell death.
    C. Cells reproduce at the same rate at which cells die.
    D. None of the above.
## Answer Key

**Cells**

<p>| | | | | |</p>
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<td>1.</td>
<td>T</td>
<td>4.</td>
<td>F</td>
<td>7.</td>
</tr>
<tr>
<td>2.</td>
<td>F</td>
<td>5.</td>
<td>T</td>
<td>8.</td>
</tr>
<tr>
<td>3.</td>
<td>F</td>
<td>6.</td>
<td>T</td>
<td></td>
</tr>
</tbody>
</table>

**Metamorphosis**