2 Creature Features

MODELING

1–2 CLASS SESSIONS

ACTIVITY OVERVIEW

NGSS CONNECTIONS

Students begin to use the practice of developing and using models to show and revise their ideas about genes and inheritance of traits as they read about and develop tentative explanations for an imaginary scenario in which animals are bred to produce two generations of offspring. This activity begins a sequence in which students explore core ideas and concepts related to patterns of inheritance of traits and cause-and-effect relationships between genes and traits as a result of sexual reproduction. Students also begin to engage in scientific argumentation as they evaluate possible hypotheses.

NGSS CORRELATIONS

Performance Expectations

Working towards MS-LS3-2: Develop and use a model to describe why asexual reproduction results in offspring with identical genetic information and sexual reproduction results in offspring with genetic variation.

Disciplinary Core Ideas

MS-LS1.B Growth and Development of Organisms: Organisms reproduce, either sexually or asexually, and transfer their genetic information to their offspring.

MS-LS3.B Variation of Traits: In sexually reproducing organisms, each parent contributes half of the genes acquired (at random) by the offspring. Individuals have two of each chromosome and hence two alleles of each gene, one acquired from each parent. These versions may be identical or may differ from each other.

Science and Engineering Practices

Developing and Using Models: Develop a model to describe unobservable mechanisms.

Constructing Explanations and Designing Solutions: Construct an explanation that includes qualitative or quantitative relationships between variables that predict or describe phenomena.

Engaging in Argument from Evidence: Construct and present oral and written arguments supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon or a solution to a problem.

Crosscutting Concepts

Patterns: Patterns can be used to identify cause and effect relationships.

Cause and Effect: Cause and effect relationships may be used to predict phenomena in natural systems.

Common Core State Standards—ELA/Literacy

RST.6-8.7: Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table).

WHST.6-8.1: Write arguments focused on discipline-specific content.

WHST.6-8.9: Draw evidence from informational texts to support analysis, reflection, and research.

SL.8.1: Engage effectively in a range of collaborative discussions (one-on-one, in groups, teacher-led) with diverse partners on grade 8 topics, texts, and issues, building on others' ideas and expressing their own clearly.

WHAT STUDENTS DO

Students read about an imaginary breeding scenario. Stop to Think questions prompt them to develop hypotheses to explain the results of genetic crosses in a story about zoo scientists breeding imaginary creatures. They use models to evaluate how well the hypotheses fit additional evidence about the critter offspring.

MATERIALS AND ADVANCE PREPARATION

- *For the teacher*

  1 Visual Aid 2.1, "Critters Breed 1"
  1 Visual Aid 2.2, "Critters Breed 2"
  1 Visual Aid 2.3, "Critters Breed 3"
  1 Visual Aid 2.4, "Critter Template"
  orange and blue overhead transparency pens or transparent plastic disks (optional)
  *1 piece of chart paper (unlined or lined)
  *1 overhead projector or document camera (optional)
  1 Scoring Guide: DEVELOPING AND USING MODELS (MOD) (optional)

- *For the class*
  - *8 pieces of chart paper (unlined or lined)
  - *8 blue markers
  - *8 orange markers
  - *8 black markers

- *For each group of four students*
  - 20 orange plastic disks
  - 30 blue plastic disks
  - *1 copy of Visual Aid 2.4, "Critter Template" on chart paper
  - orange, blue, and black colored pencils

- *For each student*
  - 1 Student Sheet 2.1, "Modeling Genes"
  - 1 Student Sheet 2.2, "Alternative Hypotheses" (optional)

**not included in kit*

Review the Doing the Activity portion of Teaching Steps and decide if you will distribute Student Sheet 2.2, "Alternative Hypotheses," or provide it as a visual aid. The first time you teach the activity, you may want to hold some sheets in reserve and supply them only to those classes or students who need them.

You or a student helper should use a thick black marker to make copies of Visual Aid 2.4, "Critter Template," on enough pieces of chart paper so that you and each group of four will have a copy. (This can be done in about 5 minutes.) Alternatively, you can have each group of students copy their own template onto chart paper.

If you haven't already done so, plan when to set up the *Nicotiana* seedling demonstration for the activity "Do Genes Determine Everything?"

TEACHING SUMMARY

GET STARTED

1. Explore students' ideas about gene transmission.

   Begin by asking students why children of the same biological parents (siblings) are almost never identical.

2. Explain the scenario and goal of this activity.

   a. Have students read the introduction and clarify the goal of the activity.

   b. Review the term *gene*, which is formally defined in the Student Book for this activity.

c. Explain scientists' use of breeding plants and animals to study genetic traits.

d. Introduce the value of model organisms for genetics investigations.

DO THE ACTIVITY

3. If you have not previously done so, introduce the SEPUP model for collaborative work.
    a. Introduce SEPUP's 4–2–1 model for collaborative work.
    b. Clarify which situations are appropriate for collaboration and which are appropriate for working independently.
    c. Introduce strategies for effective group interaction, and introduce the strategy for "Developing Communication Skills," found in Appendix E in the Student Book.
4. Tell the story of the critters. Discuss Part A of the scenario in the reading and develop possible explanations, also called *hypotheses*, for the transmission and behavior of genes.
    a. Read aloud Part A of the story or have students read the text.
    b. (LITERACY) Support reading or listening comprehension and the development of explanations with the Stop to Think strategy.
    c. Allow time for students to discuss Stop to Think 1 in pairs or groups of four, and then discuss students' ideas with the class.
5. (LITERACY) Continue to read aloud the story or have students read and respond to Part B.
    a. Show Visual Aid 2.2, "Critters Breed 2," and have students work on a response to Stop to Think 2.
    b. Ask each group to share one hypothesis with the class in response to Stop to Think 2 and use their suggestions to develop a list of hypotheses on the board or chart paper.
6. Have students read and respond to Part C.
7. Students model the transfer of genes from parents to offspring.
    a. Introduce modeling and the use of colored disks to represent bits of information for orange and blue tail color and explain how to use Student Sheet 2.1, "Modeling Genes."

b. Tell students that many lines of evidence suggest that bits of information called *genes* are present within cells and that copies are made and passed to the offspring.

c. Have students use the Critter Templates and disks to explore models of the hypotheses.

d. Circulate around the classroom to help groups get started.

BUILD UNDERSTANDING

8. Discuss the students' models and how the models help them to think about the hypotheses.

   a. Choose three groups of students to demonstrate the three hypotheses.

   b. Introduce how scientists define evidence and how they use evidence in the science and engineering practice of engaging in argument from evidence, or argumentation.

   c. Have students engage in an oral argument about which hypothesis, or possible explanation, is best supported by the evidence.

   d. (MOD QUICK CHECK) Discuss the models students drew for Analysis item 2, and provide feedback for making the models more complete.

9. If you have not done so in previous units, introduce the crosscutting concepts of patterns, and cause and effect.

   a. Explain that crosscutting concepts bridge disciplines.

   b. Introduce the crosscutting concept of patterns.

   c. Introduce the crosscutting concept of cause and effect: mechanism and explanation.

TEACHING STEPS

GET STARTED

1. Explore students' ideas about gene transmission.

   Begin by asking students why children of the same biological parents (siblings) are almost never identical.

   Listen carefully to students' responses, which may relate to the idea of children getting different numbers or kinds of genes from their two parents. These responses will help you to address students' ideas during the activity. The case of identical twins is the one exception.

2. Explain the scenario and goal of this activity.

   a. Have students read the introduction and clarify the goal of the activity.

      Explain that in this unit, students will investigate how inherited traits are passed from parents to their offspring and then to subsequent generations. In this activity, students will model their current ideas about how genes are transmitted.

   b. Review the term *gene*, which is formally defined in the Student Book for this activity.

      When a word is formally defined in an activity, it appears in bold type in the Key Vocabulary list. Encourage students to use these words when talking or writing about science. During discussions, listen for these words to see if students are using them correctly. Decide how you will support students' understanding of the vocabulary—perhaps by setting up a word wall in the classroom. For more suggestions on ways to develop students' understanding of and proficiency with scientific vocabulary, see Teacher Resources II "Diverse Learners."

   c. Explain scientists' use of breeding plants and animals to study genetic traits.

      Breeding is the deliberate mating of two individuals to produce offspring with desired characteristics, to maintain a species, or to study the genetics of a species. Breeding has played a key role in developing dog and cat breeds, in modern agriculture and husbandry to improve crops and livestock, and in zoo programs aiming to increase the population of endangered species. You may wish to discuss the importance of breeding new varieties of animals and plants to modern careers in agriculture.

   d. Introduce the value of model organisms for genetics investigations.

      Explain that breeding experiments to study genetics are often done with organisms with a short generation time; this allows several generations of offspring to be produced within a fairly short time span. These organisms are considered to be models for the general principles of genetics. This use of model is related to, but somewhat different from, the use of modeling as a scientific and engineering practice.

DO THE ACTIVITY

3. If you have not previously done so, introduce the SEPUP model for collaborative work.

   a. Introduce SEPUP's 4–2–1 model for collaborative work.

      Explain that many of the activities in this book use the SEPUP 4–2–1 cooperative learning model. Students work in groups of four or in pairs to share, discuss, compare, and revise their ideas and to conduct investigations and activities. In all cases, each individual student is responsible for contributing ideas, listening to others, recording and analyzing their results, and monitoring their own learning. To learn more about SEPUP's 4–2–1 cooperative learning model, see Teacher Resources I: "Course Essentials."

   b. Clarify which situations are appropriate for collaboration and which are appropriate for working independently.

      In science, collaboration is essential to the development of new ideas and to a better understanding of scientific concepts. However, scientists must publish only their own work and must give others credit when they build on others' ideas.

   c. Introduce strategies for effective group interaction, and introduce the strategy for "Developing Communication Skills," found in Appendix E in the Student Book.

      Explain or model what productive group interactions and communication (both agreement and constructive disagreement) look like and sound like. For more information about group work, including optional Student Sheets to help support students' interactions, see the Facilitating Group Interactions section of Teacher Resources II, "Diverse Learners."

4. Tell the story of the critters. Discuss Part A of the scenario in the reading and develop possible explanations, also called *hypotheses*, for the transmission and behavior of genes.

   a. Read aloud Part A of the story or have students read the text.

      Reading aloud or telling the story of the creature-breeding scenario while students keep their books closed helps to engage the students and also discourages students from looking ahead to Part B. Encourage students to relate the information in the story to the information in the diagrams on the Visual Aids.

Use Visual Aid 2.1, "Critters Breed 1," to illustrate the beginning of the story. The Stop to Think questions can be projected from the slide presentation for this unit. You might wish to explain that the term *generation* in genetics is used very specifically to refer to the parents (first generation), their children (offspring, or second generation), and their "grandchildren" (third generation). This is in contrast to day-to-day use of the term to refer to people born during a particular time period.

b. (LITERACY) Support reading or listening comprehension and the development of explanations with the Stop to Think strategy.

Stop to Think questions serve a different function than the Analysis items found at the end of the activity. They are usually designed for you and the students to monitor comprehension as students proceed through the reading. However, in this activity, they are used to prompt discussion and development of explanations. If you are reading the story, you can read and have students discuss the Stop to Think questions. Since the goal of the Stop to Think questions in this Activity is to find out what students think as they read rather than to provide a correct answer given in the passage, sample answers are not provided. Instead, guidance for discussing each Stop to Think question is provided in the teaching suggestions that follow. For more information on this strategy, see the Literacy section of Teacher Resources II, " Diverse Learners."

c. Allow time for students to discuss Stop to Think 1 in pairs or groups of four, and then discuss students' ideas with the class.

Student responses will vary. They may suggest all blue or orange tails, some of each, or some kind of striping, spotting, or other mixture of tail colors.

It is possible that one or several students will introduce the idea of one color being dominant over another. If so, write the word *dominant* on the board and have students suggest an operational definition, such as the idea that one color might overwhelm another. Students are often familiar with the idea of dominance in the context of brown and blue eye color. If no students suggest the term, wait until later to introduce it.

5. (LITERACY) Continue to read aloud the story or have students read and respond to Part B.

a. Show Visual Aid 2.2, "Critters Breed 2," and have students work on a response to Stop to Think 2.

Note the use of a circle in a square to represent an individual without specifying whether it is a male or female. Give them about 5 minutes to formulate and record their hypotheses.

b. Ask each group to share one hypothesis with the class in response to Stop to Think 2, and use their suggestions to develop a list of hypotheses on the board or chart paper.

Student responses will vary. They may suggest that blue color is stronger, or dominant, to orange. They might think both colors are in the tails, but blue swamps the orange. At this point, the term *dominant* may appear if it has not already. Address it as suggested previously.

The hypotheses provided on optional Student Sheet 2.2, "Alternative Hypotheses," are likely to represent most or all of the students' explanations, and you can use it to clearly state the three major hypotheses possible. Or you can use the hypotheses exactly as they are developed by the class. The latter provides a more open-ended experience and encourages greater student independence. If you use Student Sheet 2.2, allow some time for students to determine which of the three hypotheses on the Student Sheet is closest to their own. Emphasize the idea that a number of hypotheses can be generated but that each must be closely compared with the evidence to see if it is supported. If the evidence contradicts predictions of the hypothesis, the hypothesis has been refuted.

6. Have students read and respond to Part C.

Use Visual Aid 2.3, "Critters Breed 3," to discuss the third-generation results. Allow students some time to discuss Stop to Think 3. Some students may quickly argue that any models that resemble Hypothesis B on Student Sheet 2.2 are not possible. Do a quick count of which hypothesis students favor. Ask a few students to explain their reasoning to the class, and discuss and summarize students' comments.

7. Students model the transfer of genes from parents to offspring.

a. Introduce modeling and the use of colored disks to represent bits of information for orange and blue tail color and explain how to use Student Sheet 2.1, "Modeling Genes."

Explain that developing and using models to support explanations and predictions is a key scientific practice. Review the definition of a model as a representation of a system scientists use to help one understand and communicate how the system works. Explain that a model can be a physical model, a drawing, a mathematical equation, a computer simulation, or any other way of representing a system that is useful for understanding and predicting phenomena.

Teacher's note: You can make the activity more open-ended by omitting the use of Student Sheets 2.1 and 2.2. Use the minimum amount of support needed by your students.

b. Tell students that many lines of evidence suggest that bits of information called *genes* are present within cells and that copies are made and passed to the offspring.

This idea of copies being transmitted is important; otherwise, students may get the idea that the parents could run out of genes to give to their offspring. If students mention chromosomes or DNA, ask them if they can define these terms. If they are familiar with them from previous experiences, briefly review them. If not, these ideas can wait until a later activity, "Show Me the Genes!" The students (like Mendel) can think about genes without knowing exactly where they are or of what they are made.

c. Have students use the Critter Templates and disks to explore models of the hypotheses.

Students should use the models to explore which of the hypotheses best explains the results of the creature-breeding program, and whether they can rule out any of the hypotheses. If you are using Student Sheet 2.1, review its Procedure steps. You may have to demonstrate how to begin developing the model. Use a Critter Template and the transparent blue and orange plastic disks to demonstrate on an overhead projector or document camera how to model one of the hypotheses, following the steps on Student Sheet 2.1. Encourage students to look for logical rules for how genes are passed from parents to offspring.

d. Circulate around the classroom to help groups get started.

When necessary, prompt groups to begin by placing an equal number of blue disks in Skye's outline and orange disks in Poppy's outline. For each hypothesis, groups should place the hypothesized number of orange and blue disks in the second-generation offspring. Then they should decide on the number of orange and blue disks to place in each of the third-generation offspring.

BUILD UNDERSTANDING

8. Discuss the students' models and how the models help them to think about the hypotheses.

   a. Choose three groups of students to demonstrate the three hypotheses.

      They can do this by taping disks or drawing on a piece of chart paper or overhead transparency or by using the document camera and the plastic disks you used for the demonstration. Allow students to comment on whether their favored model was the same as or different from the one presented. They will be asked to draw their models for Analysis item 2. You may wish to distribute chart paper and provide colored markers for their drawings.

      Teacher's note: Although the term allele will not be formally introduced until the Gene Combo activity, you can begin to use it here if students begin to see a need for a term describing the information for blue vs. orange.

   b. Introduce how scientists define evidence and how they use evidence in the science and engineering practice of engaging in argument from evidence, or argumentation.

      Like scientists, students will use evidence to develop explanations, construct scientific arguments, and recommend solutions to problems. Explain that scientific *evidence* is information that supports or refutes a scientific explanation or argument. In this activity and unit, students will use evidence to develop models, explanations, and arguments for the mechanisms of genetic inheritance.

      Review Analysis item 1, which asks students to argue in favor of one of the explanations provided in the three hypotheses. Explain that argumentation is a process scientists use to evaluate competing explanations, or hypotheses. The process is based on using evidence and reasoning to decide which explanation is the best fit with the evidence. This practice will be further developed throughout the unit.

   c. Have students engage in an oral argument about which hypothesis, or possible explanation, is best supported by the evidence.

      Listen to students' ideas, focus on evidence they provide, and clarify any discrepancies in their reasoning, allowing them to argue for and against the three hypotheses. By this time, students should have rejected Hypothesis B because the evidence conflicts with this explanation, but they might still consider A or C to be possible. However, very few students, if any, will have come to the "correct" reasoning about Hypotheses A and C.

Leave the question of whether A or C is correct open until after the next activity (which allows students to explore Hypothesis C in more depth), when you can return to the models. Some students may be developing the idea that each parent contributes half the genes to the offspring, but others may still question that idea.

d. (MOD QUICK CHECK) Discuss the models students draw for Analysis item 2 and provide feedback for making the models more complete.

Have students present their models and discuss whether they are complete. Provide feedback to help students revise and improve their models. At this point, the models are works in progress and may include some ideas that don't align with the models used by scientists, but they should represent students' current thinking as completely as possible.

QUICK CHECK indicates an opportunity for formative assessment of key concepts. You may wish to use Analysis item 2 as a QUICK CHECK for formatively assessing students' models at this time. You might also wish to consult the DEVELOPING AND USING MODELS (MOD) Scoring Guide as you provide feedback, but we suggest waiting until the next activity to introduce the Scoring Guide to students, unless you have introduced it in previous units. For more information on Quick Checks, see Teacher Resources III, "Assessment."

9. If you have not done so in previous units, introduce the crosscutting concepts of patterns, and cause and effect.

a. Explain that crosscutting concepts bridge disciplines.

They can be a lens or touchstone through which students make sense of phenomena and deepen their understanding of disciplinary core ideas. Refer students to Appendix G, "Crosscutting Concepts," and point out the symbols and discuss definitions provided.

b. Introduce the crosscutting concept of patterns.

Display the definition and symbol used for Patterns in Appendix G, "Crosscutting Concepts." The pattern can be structural, as shown in the diagram, or a pattern in events, such as the phases of the moon (or the pattern of results in genetic crosses, as in this activity). Point out to students that seeing patterns in nature can lead scientists to organize and classify their observations. It can also lead them to ask questions about relationships and the causes of patterns. Students will look for patterns when they analyze and interpret data, ask questions about the patterns they observe, and suggest cause-and-effect relationships to explain patterns.

c. Introduce the crosscutting concept of cause and effect: mechanism and explanation.

Scientists investigate and try to explain how things work, and try to figure out what causes various events. Introduce the symbol for Cause and Effect in Appendix G, "Crosscutting Concepts," which shows a simple diagram of cause and effect, where A (the cause) might or might not cause B (the effect) to happen. For example, in this activity, specific gene combinations might cause certain tail colors. The genes present are the cause, and the tail color produced is the effect.

SAMPLE RESPONSES TO ANALYSIS

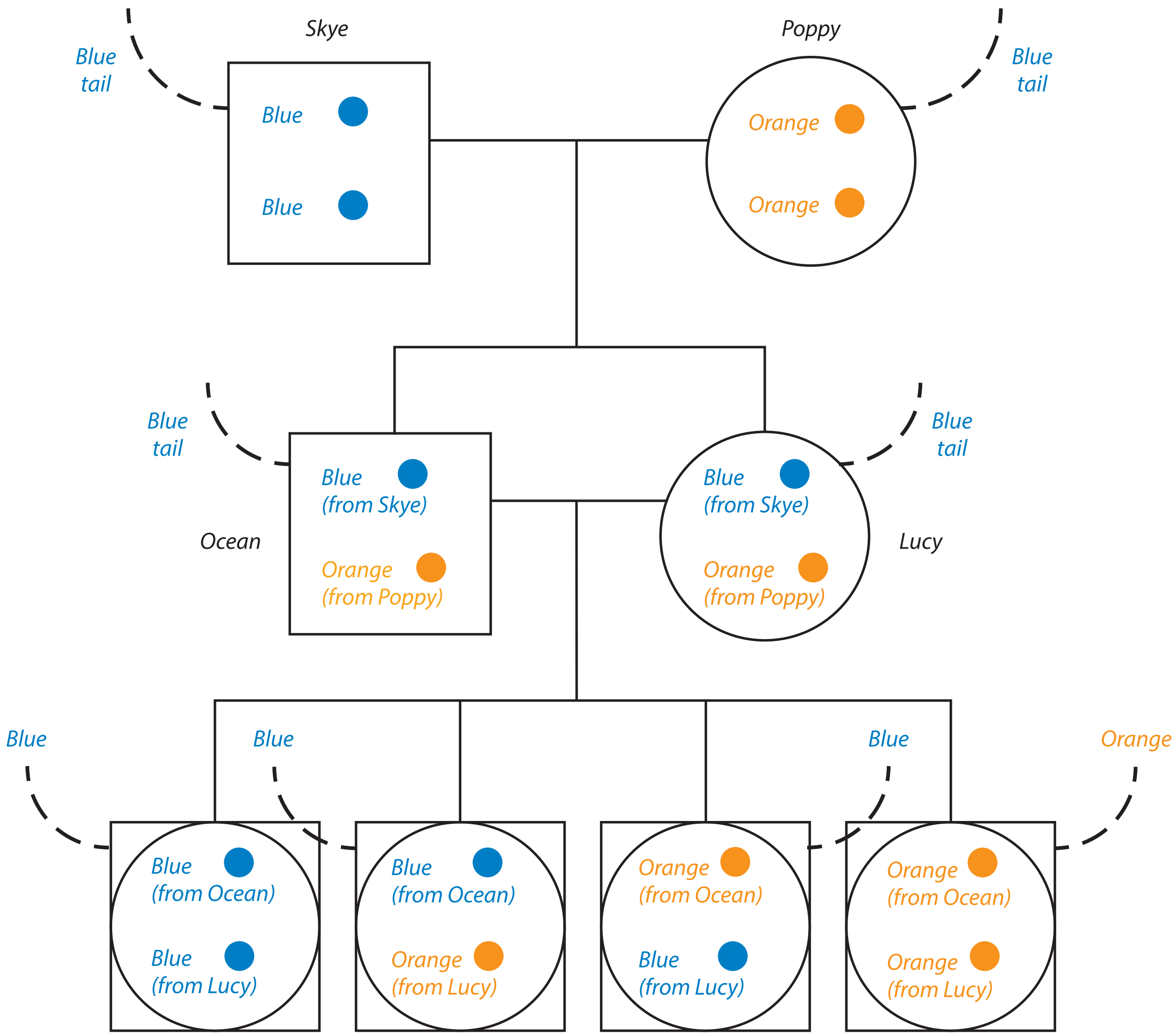
1. Based on the breeding results and your models, which hypothesis do you think best fits the evidence? Explain your answer.

   Student responses may vary, depending on the hypotheses they considered. One sample response is shown here:

   I think Hypothesis A or C fits the evidence, but B does not. If we follow Hypothesis B, there wouldn't be any orange genes in the second generation in this model. That gives us no way to explain the reappearance of the orange-tail trait in the third generation. Only Hypothesis A or C could explain why the orange trait is invisible in the second generation and then reappears in the third generation.

2. (MOD QUICK CHECK) Draw a diagram of the model you created for the hypothesis that you think best fits the evidence. Be sure to

   - add labels.
   - write a caption to help others understand your diagram.



3. A **pattern** is something that happens in a repeated and predictable way. What pattern do you see with the orange-tail trait as it passes from Skye and Poppy to their children and grandchildren?

   I see a pattern where even though one parent has the trait in the first generation, it disappears in the second generation, and then reappears in 1/4 of the offspring in the third generation.

4. What do you think might cause the pattern in Analysis item 3?

   I think the orange tails only show up when there are no blue-tail genes. Since all the second generation get a blue-tail gene from Skye, the orange-tail genes are hidden, but all the offspring have one blue-tail and one orange-tail gene. When Skye and Poppy have offspring, about 1/4 get an orange-tail gene from both parents, so their tails are orange.

REVISIT THE GUIDING QUESTION

How are simple inherited traits passed from parents to their offspring and then to the next generation?

Review the idea that traits are passed during reproduction as information in genes, but genes that are hidden in one generation might reappear in later generations. This is just part of the answer that students will continue to build throughout the next several activities.

ACTIVITY RESOURCES

KEY VOCABULARY

breeding

crossing

evidence

gene

heredity

hypothesis

inherited

model

pattern

BACKGROUND INFORMATION

THE CRITTERS AS A MODEL FOR BREEDING EXPERIMENTS

This activity is based on results similar to those obtained by Mendel in his investigations of peas. These studies provided the basis for our understanding of genetics. Do not bring up the subject of Mendel and his experiments with peas at this time—they will be addressed in the activity, "Mendel, First Geneticist."

We are using an imaginary creature to simulate the behavior of genes because this is engaging and motivating to students. Also, the imaginary creatures will be constructed in the "Breeding Critters—More Traits" activity to investigate multiple traits and the diversity of individuals within a species. Although the critters are imaginary, the results presented are similar to the actual behavior of genes in humans and other organisms.

Students are given a chance to formulate their own hypotheses and then determine how well they fit the evidence provided. This approach gives students a chance to think about the evidence while giving you a chance to hear students' ideas about heredity. In this activity, the students focus only on the tail colors of the critters, but in "Breeding Critters—More Traits," students will explore several more differences between the two strains of critters.

A reasonable expectation for this activity will be the rejection of Hypothesis B, which is inconsistent with the reappearance of the orange tail in the third generation. Distinguishing between Hypothesis A and Hypothesis C will not be possible for most students until they complete the next two activities: "Reproduction" and "Gene Combo."

REFERENCES

Soderberg, P. (1992, November). Marshmallow meiosis. *The Science Teacher, 59*(8), 28–31. The critters in this activity are based on an activity first presented in this Soderberg article.

Name____ Date__________

STUDENT SHEET 2.1

MODELING GENES

Scientists often construct simple models that help them test hypotheses. In this activity, you will use colored disks to represent genes for tail color. You can think of the genes as bits of information that carry directions for the traits of the organism.

CHALLENGE

How are simple inherited traits passed from parents to their offspring and then to the next generation?

MATERIALS

For each group of four students

1 copy of Visual Aid 2.4, "Critter Template"
20 orange plastic disks
30 blue plastic disks

PROCEDURE

1. **Decide which hypothesis you will model first.**
2. **Assume that each critter has the same total number of tail-color genes. To keep your simulation simple, decide with your partner whether to try the simulation with 2, 3, or 4 tail-color genes in each critter.**
3. **Place the number of orange tail-color genes (orange disks) you have chosen into Poppy's outline on your critter-breeding template.**
4. **Place the number of blue tail-color genes (blue disks) you have chosen into Skye's outline on your critter-breeding template.**
5. **Decide how many genes you think each parent (Skye and Poppy) gives to each offspring. Don't take the genes away from Skye and Poppy. Skye and Poppy give copies to their offspring. Take the copies you need from your pile of disks. Place the appropriate number of orange and blue disks in the outline for each offspring. Remember, each offspring has to have the same total number of tail-color genes as Skye and Poppy.**
6. **Review what you did in Steps 4 and 5. Be sure it fits the hypothesis you are modeling.**
7. **Decide how many blue and orange genes you think each parent in the second generation gives to each of the offspring in the third generation. Try to develop a logical model that will result in approximately 3 blue-tailed creatures for every 1 orange-tailed creature. Place the number of blue and orange disks that each offspring must receive into the outlines for the third-generation offspring.**
8. **Keep a record of your group's model. Be prepared to explain your ideas to the class.**
9. **Next try simulating the transfer of genes from Poppy and Skye to their offspring according to each of the other hypotheses developed in class. Follow Steps 1–7.**
10. **Answer the Analysis items in your Student Book.**

Name____ Date__________

STUDENT SHEET 2.2

ALTERNATIVE HYPOTHESES

After a lengthy discussion, the scientists decide that they have three different ideas for what happened when the blue- and orange-tailed critters were bred.

Hypothesis A:

Each critter pup got most of its tail-color genes from the parent with a blue tail and only a little genetic information from the parent with an orange tail.

Hypothesis B:

Each critter pup got all of its tail-color genes from the parent with the blue tail. (None came from the parent with the orange tail.)

Hypothesis C:

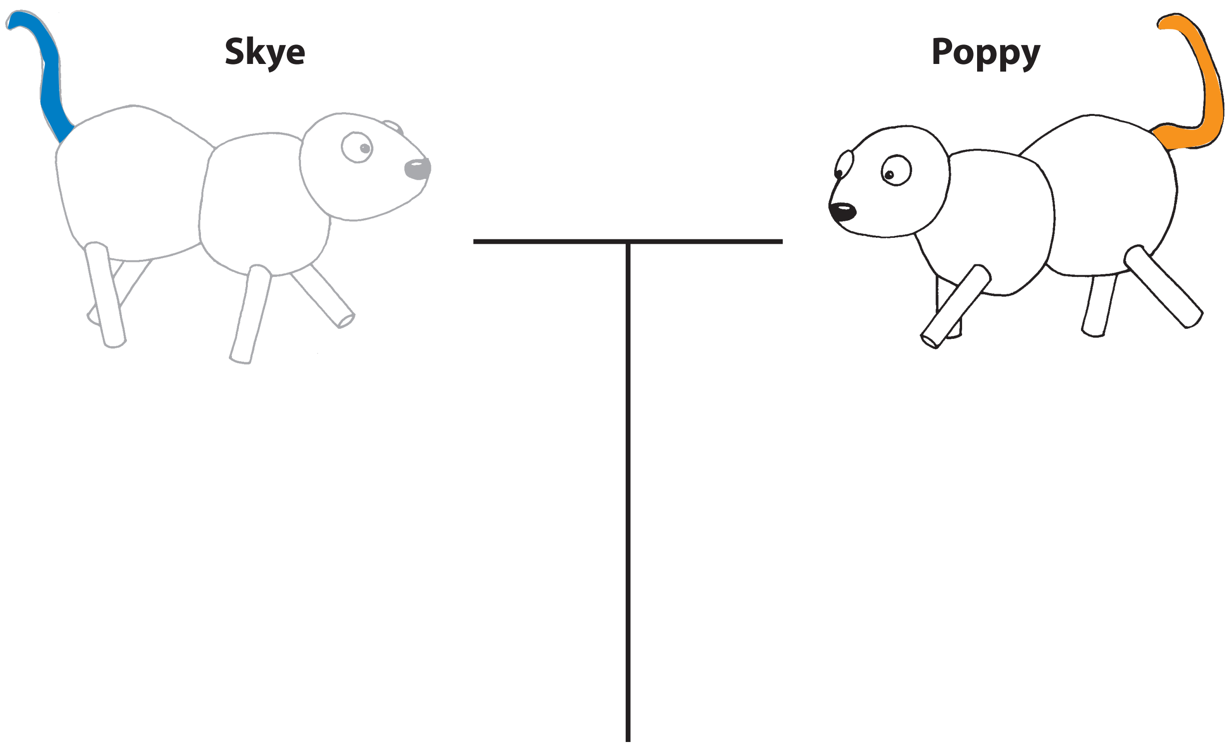
Each critter pup got half of its tail-color information from each parent, but the information from the blue-tailed parent overwhelms the information from the orange-tailed parent.

ANALYSIS

Discussion with your group: Which hypothesis is most like your original hypothesis? Explain.

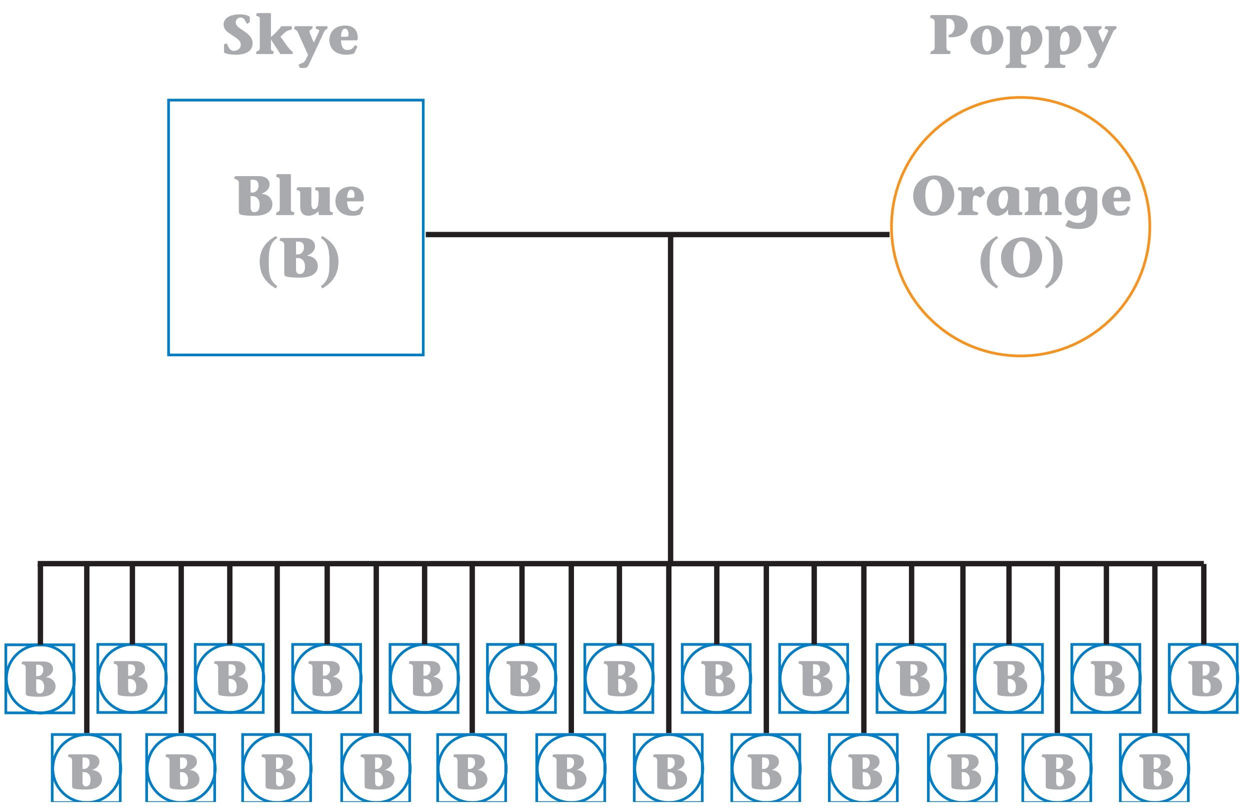
VISUAL AID 2.1

CRITTERS BREED 1



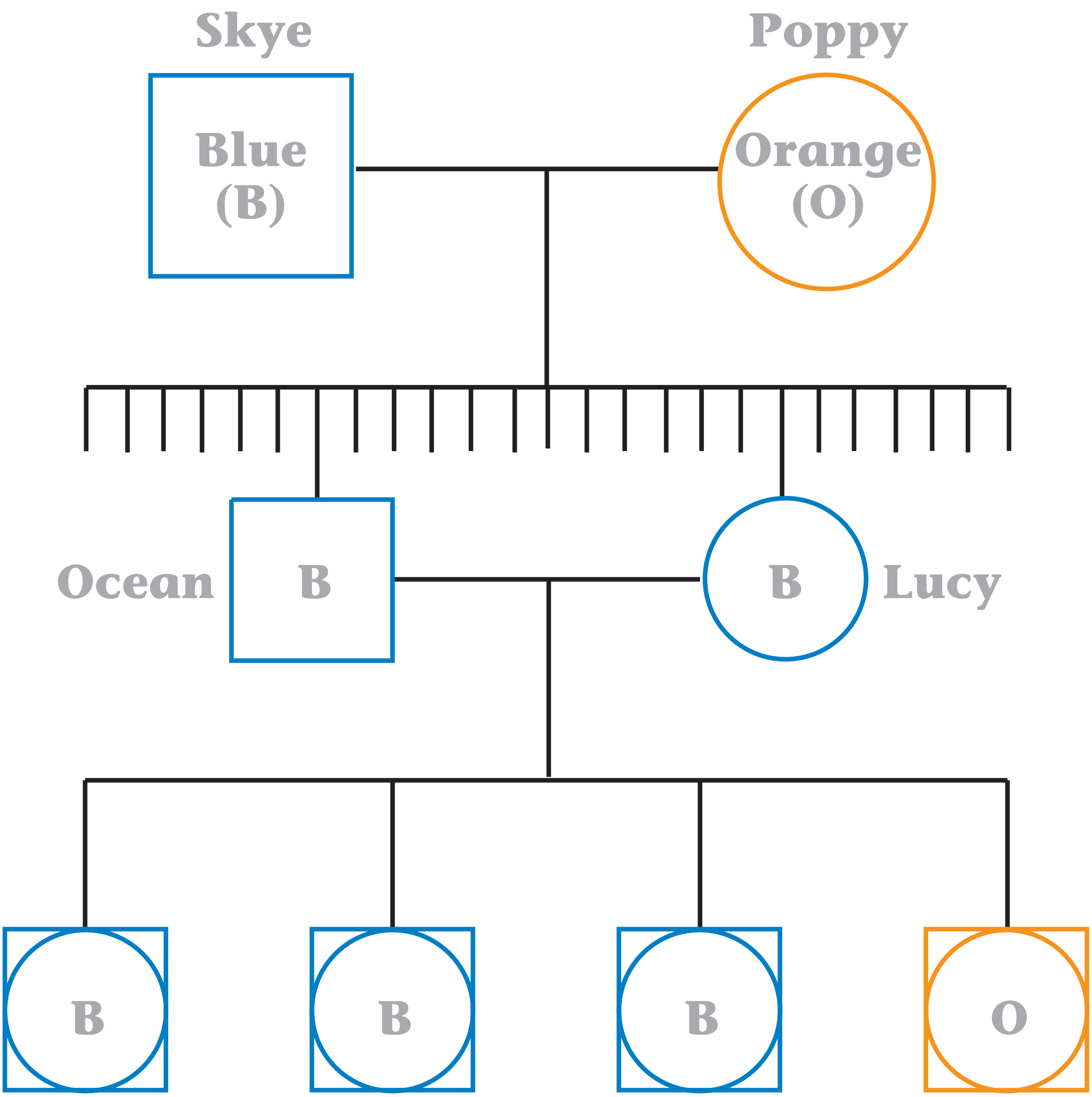
VISUAL AID 2.2

CRITTERS BREED 2



VISUAL AID 2.3

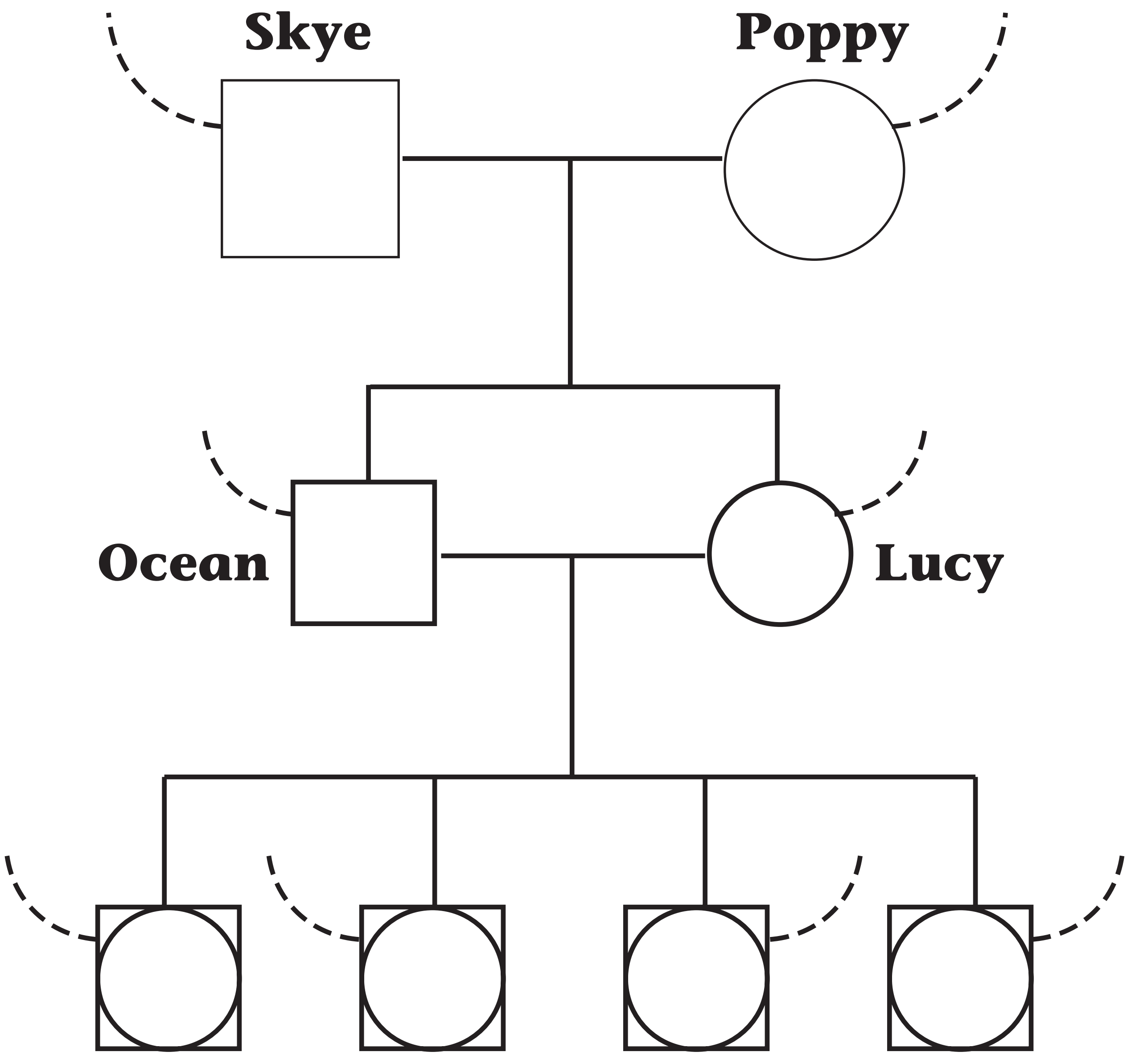
CRITTERS BREED 3



The ratio of blue-tailed to orange-tailed offspring is approximately 3:1.

VISUAL AID 2.4

CRITTER TEMPLATE



VISUAL AID 2.5

ALTERNATIVE HYPOTHESES

After a lengthy discussion, the scientists decide that they have three different ideas for what happened when the blue- and orange-tailed critters were bred.

Hypothesis A:

Each critter pup got most of its tail-color genes from the parent with a blue tail and only a little genetic information from the parent with an orange tail.

Hypothesis B:

Each critter pup got all of its tail-color genes from the parent with the blue tail. (None came from the parent with the orange tail.)

Hypothesis C:

Each critter pup got half of its tail-color information from each parent, but the information from the blue-tailed parent overwhelms the information from the orange-tailed parent.

ANALYSIS

Discuss with your group: Which hypothesis is most like your original hypothesis? Explain.