

Constructing and Testing a Dichotomous Key Model for Fruit

A Carolina Essentials™ Investigation



Overview

This investigation requires students to create and test a model for fruit classification. It may be used as an introductory inquiry into taxonomy for life science classes or as an NGSS Dimension 1 Practice (developing and using models) in life science, botany, or agricultural science classes. Students observe the exterior of common fruits, group fruits based on observations, dissect the fruits, and then regroup as necessary. Students will convert the classification model into a true dichotomous key. Students will evaluate the dichotomous keys by classifying 2 additional fruits.

Life Science

Grades: 6–10

TIME REQUIREMENTS



PREP | **ACTIVITY**
30 min | 30-45 min

Teacher Prep: 30 min

Student Activity: 30-45 min

SAFETY REQUIREMENTS



Essential Question

How are observable physical properties used to classify living things?

Investigation Objectives

1. Use common fruit to construct a dichotomous key for fruit types.
2. Classify fruits using the dichotomous key.

Next Generation Science Standards* (NGSS)

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
<p>Engaging in Argument from Evidence</p> <ul style="list-style-type: none"> • Construct an argument with evidence, data, and/or a model. (LS1-1) • Use an oral and written argument 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. (MS-LS1-4) 	<p>LS1.A: Structure and Function</p> <ul style="list-style-type: none"> • Plants and animals have both internal and external structures that serve various functions in growth, survival, behavior, and reproduction. (LS1-1) 	<p>Systems and System Models</p> <ul style="list-style-type: none"> • A system can be described in terms of its components and their interactions. (LS1-1) <p>Cause and Effect</p> <ul style="list-style-type: none"> • Phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability. (MS-LS1-4)

Safety Procedures and Precautions

Ask students about food allergies several days prior to the investigation to ensure fruit substitutions do not have to be made. Caution students about using the plastic knife. All incisions should be done away from students' bodies. Students should wear safety glasses and gloves. Students should not eat the fruit.

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MATERIALS (PER GROUP)

- 1 corn kernel (frozen)
- 1 grape (any variety)
- 1/4 orange, lemon, lime, or other citrus fruit
- 1 cherry (any variety)
- 1 blueberry
- 1/4 apple (any variety)
- 1/4 pear (any variety)
- 1 blackberry
- 1 snow pea pod
- 1 green bean pod
- 1 pecan or walnut
- 1 pint-size resealable bag
- 1 plastic knife
- 1 nutcracker or small rock hammer
- Butcher paper or craft paper to cover desks

REFERENCE KITS

[Inquiries in Science: Classifying Across the Kingdoms Kit](#)

Ladybugs in the Classroom Kit

Ladybugs in the Classroom Demonstration

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Teacher Preparation and Disposal

Prepare a resealable bag of fruits for each group of students before the investigation. Ensure that fruits are intact and firm. All fruits and plastic knife may be disposed of in the classroom trash. **Note:** Students may not develop identical models. The task is to use common characteristics among the fruit to develop a classification model. At the close of the activity, discuss the different student models and compare them to the included partial key. Emphasize the differences between a classification model and a dichotomous key.

Student Procedure

1. Cover the workspace with butcher paper or craft paper before observing the fruit.
2. Observe the exterior of all pieces of fruit.
3. Group the fruit into 2 groups by similar characteristics.
4. Record the reason(s) for your fruit groupings.
5. Keep the fruit in groups and use the knife or nutcracker to dissect the fruit. Slice through the fruit, beginning at the stem. Make observations.
6. Remove the outside layer from one half of the fruit. Make observations.
7. Remove any seeds from the fruit. Make observations.
8. Use the dissecting observations to classify the fruit into specific categories. Depending on the detail, you should have 6 to 8 categories.
9. Sketch your final fruit classification model below.
10. Convert the classification model into a dichotomous key by asking yes or no questions for each category on the model. Each question should reflect an identifying fruit characteristic.

Model Assessment

1. Switch dichotomous keys with another group.
2. Obtain the fruit for testing the dichotomous key.
3. Identify the fruit type for the test fruits.
4. Compare your model and dichotomous key to other groups.

Data and Observations

Student answers will vary. The first division should be single fruit or aggregate fruit (visual inspection only). Students should then group fruit into dry fruit and fleshy fruit (visual inspection only). Students will probably split the dry fruits into 3 categories: legumes, nuts, and grains (after dissection). Fleshy fruits should be separated into drupes, berries, and pomes (after dissection). Some students may add a fourth group for citrus. Aggregate fruits should not be subdivided any further.

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Teacher Preparation and Tips

Check for contact food allergies and make sure students wear gloves and glasses.

Go over the difference between a flow chart classification model and a true dichotomous key with students before they begin.

Instruct students to make incisions away from the body.

Suggest students draw the classification model directly onto the butcher or craft paper to preserve the fruit groupings. They can throw the fruit away after that.

Review what a dichotomous key is and how it is used.

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Note: This is an incomplete key. Not all classifications of fruit are represented with this sample.

Fruit	Observation 1	Observation 2
Corn kernel		
Grape		
Citrus fruit		
Cherry		
Blueberry		
Apple		
Pear		
Blackberry		
Snow pea pod		
Green bean pod		
Pecan or walnut		

Analysis and Discussion

1. Sketch the final classification scheme your group used. Include the fruit names for each classification.

Student answers will vary. The first division should be single fruit or aggregate fruit (visual inspection only). Single fruit should split into dry fruit and fleshy fruit (visual inspection only). Students will probably split the dry fruits into 3 categories: legumes, nuts, and grains (after dissection). Fleshy fruits should be separated into drupes, berries, and pomes (after dissection). Some students may add a fourth group for citrus. Aggregate fruits should not be subdivided any further. See the attached classification scheme.

2. Turn your classification scheme into a dichotomous key by writing questions that have yes or no answers that correspond to the characteristic you used to group the fruit. Example: Are multiple seeds visible on the inside of the fruit?

See the attached dichotomous key.

3. What are the fruit classifications for the banana and raspberry?

The banana is a berry and the raspberry is an aggregate.

4. Compare your group's identification model to other groups' models. Describe differences. Did the differences change the classification of the banana and raspberry?

Student answers will vary, but the characteristics used for grouping should be similar. Point that out to students in a group discussion.

5. How did your group's model and dichotomous key compare to the partial key the teacher provided?

Student answers will vary, but the characteristics used for grouping should be similar. Point that out to students in a group discussion.

6. Identify 3 other groups of living things for which you could construct a taxonomy.

Student answers will vary but may include leaves, tree bark, insects, plants, or the entire animal kingdom.

7. Select one group from question 4 and describe the properties or characteristics you would use to build a taxonomic model.

Leaves: leaf shape, leaf edge, arrangement of veins, arrangement of leaves on the stem, number of leaves on a stem, or leaf outer coating.

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TEACHER NOTES

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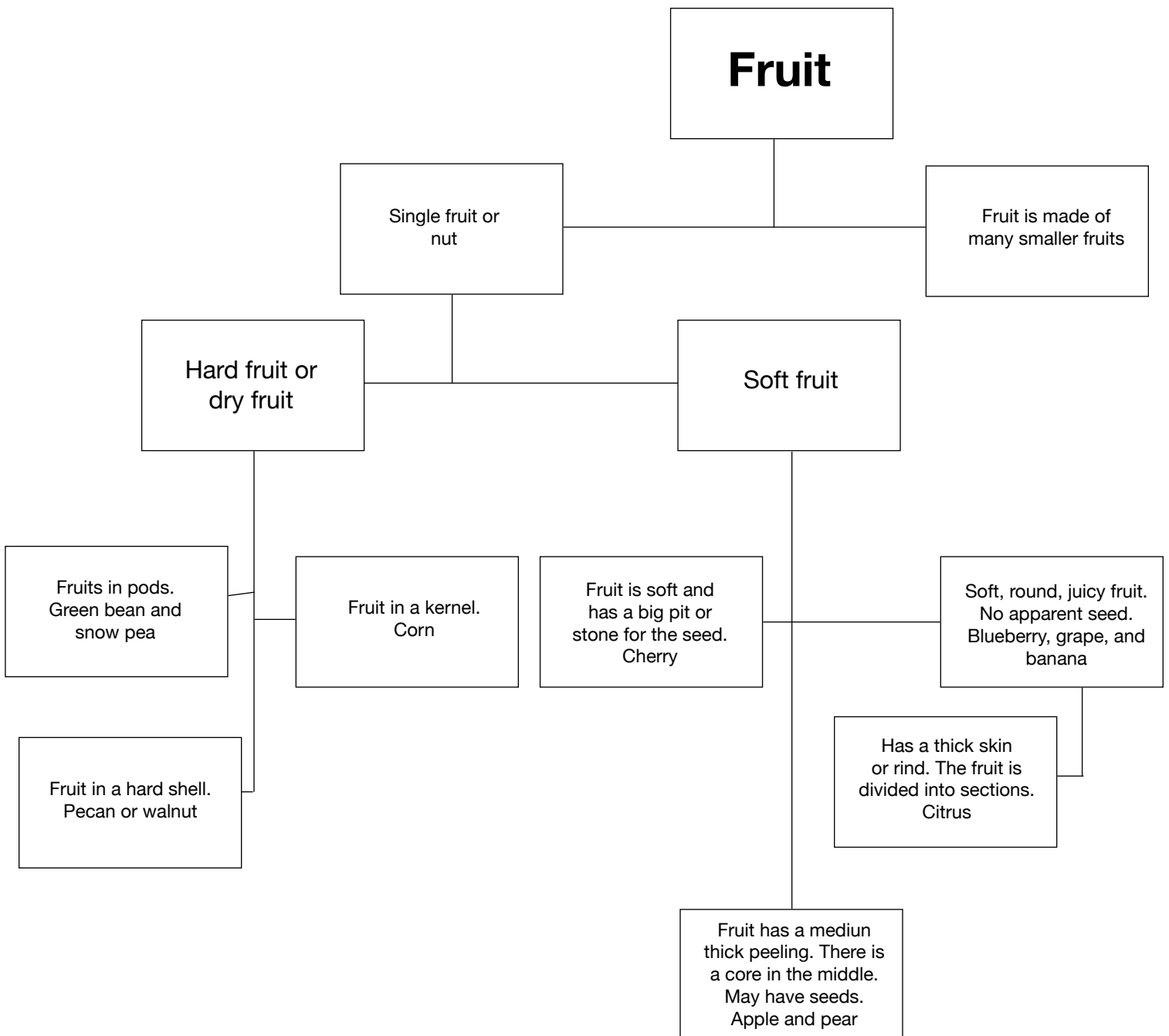
Partial Dichotomous Key for Fruit Identification

- 1a. Is the fruit simple (1 fruit)? *Go to 2a or 2b.*
- 1b. Is the fruit aggregate (multiple)? *Aggregate fruits (blackberries, raspberries, and strawberries)*
- 2a. Is the fruit dry? *Dry fruit. Go to 3a.*
- 2b. Is the fruit fleshy? *Fleshy fruit. Go to 6a, 6b, or 6c.*
- 3a. Does the seed coat open by natural means at maturity? *Dehiscent fruit. Go to 4a.*
- 3b. Does the seed coat not open by natural means at maturity? *Indehiscent fruit. Go to 5a or 5b.*
- 4a. Does the seed coat split along dorsal and ventral sutures? *Legume (beans and peas)*
- 5a. Is the fruit similar to an achene, but the fruit wall is hard and greatly thickened? *Nut (pecan, walnut)*
- 5b. Are the fruit wall and seed coat fused? *Grain (corn, wheat, grasses)*
- 6a. Is there one large, stony seed, thin skin, and a fleshy or fibrous middle? *Drupe (cherries, peaches)*
- 6b. Has the ovary wall become enlarged and juicy? *Go to 7a or 7b.*
- 6c. Is this an accessory fruit with paper-like skin? *Pome (apples, pears)*
- 7a. Is this a simple, fleshy fruit with a relatively smooth skin? *Berry (blueberries, grapes, bananas)*
- 7b. Is this a simple, fleshy fruit with a leathery rind and fruit divided by septa? *Hesperidium (citrus)*

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Student Classification of Fruit Types



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Partial Classification of Fruit Types

