This is a teacher led demonstration with student participation

Materials:

1 Large Mason jar  
12 marbles (small)  
12 shooter marbles (medium)  
12 ping pong balls (large)  
1 Hat  
Printed Temperature Sheet – at end of instructions  
  
***Before beginning place the jar in a place that is visible to students. Select three volunteers give the marbles to one, the shooters to another, and the ping pong balls to a third.***

**Teacher Reads Introduction:**

“All living things grow up. Warm blooded animals, like people, grow at a pretty regular rate. People that are the same age are generally close to the same size. Your big sister is probably taller than you, and your little brother is probably shorter than you. Most people in your class are probably taller than people in the grade below you. People get bigger every year until they become adults.

“Let’s pretend this jar is a person. When the jar is full the person will be all grown up. For every year that passes the person grows. Let’s say that the ping pong balls are how much they grow every year.”



***Ask the students to guess how many balls it will take to fill the jar. Now ask the student with the ping pong balls to come and add balls to the jar, counting each “year” until the jar is full.***

“So if people get bigger at a steady rate that means if you know how big someone is then you can probably guess how old they are. If there are two balls in the jar then you know this person is two years old. If you met a new student today I bet you could tell if they were younger or older than you.

“To grow things need to be warm. That isn’t a big deal for warm blooded animals, like people, because our bodies always keep us warm, and so we always grow at the same rate. However, things like plants and insects can’t keep themselves warm. This means that when they get cold their bodies slow down and grow slower. Plants and insects generally stop growing altogether in the winter.

“That means that two trees can be the exact same age, but if one grows in a greenhouse and the other one grows outside then the one in a greenhouse will get bigger faster. Now let’s pretend the jar is a tree. For every summer that goes by we’ll add a ping pong ball because the tree will grow a lot, and for every winter we’ll add a marble because the tree will only grow a little bit.

***Ask the students to guess how many balls it will take to fill the jar. Ask the students with the marbles and the ping pong balls to alternate putting balls into the jar and count along the “seasons” until the jar is full.***

“Insects grow much more quickly than trees or people, they can grow up in just a few days. This means that if there’s a cold day the insect grows a little, and if there’s a hot day the insect can grow a lot.

“Below 55 degrees Fahrenheit it is too cold for Monarch butterflies to grow at all. From 55-65 the Monarch will grow slowly. From 65-80 the Monarch will grow normally. From 80-95 the monarch will grow quickly. If they get any hotter than that they might start to die.”

|  |  |  |  |
| --- | --- | --- | --- |
| Below 55° F | 55-65° F | 65-80° F | 80-95° F |
| Won’t Grow | Grows Slowly | Grows Normally | Grows Quickly |
| Nothing Added | Marble | Shooter Marble | Ping Pong Ball |



***Ask for a volunteer to select temperatures from a hat filled with the slips cut from the next page. Have the student read the temperature from each day aloud to the class and have the class decide which temperature group it falls into. Have the student with the corresponding ball/marble place their ball into the jar. Count how many days it takes to fill the jar.***

“Now you know how long it would take for this monarch to grow up. If you found an adult monarch outside could you figure out how old it was? How would you do that?”

***Allow students to speculate. Fill the jar with a new assortment of balls, and explain that the jar now represents an adult butterfly you found outside. To determine how old it is you will look at the weather report for the last few days. Remove a ball from the jar for each “day” and count them as you go (i.e. if the first ball you remove is small then: “Yesterday was cold, so we know it didn’t grow much yesterday, the day before that was hot…”).***

“We measure time passing in days, and we measure temperature in degrees. This system combines measurements of time and temperature into a new measurement. What do you think this measurement should be called?”

***Allow students to speculate.***

“Scientists call these units ‘degree days’ It’s not very creative, but hopefully it makes it easier to remember that it incorporates both measurements of temperature and time. Farmers can use degree days for insects that feed on fruits and vegetables to calculate when those insects will show up in their fields. This can help them manage the damage those insects cause.”

Notes:

***Any sized balls will work, even stones, but ideally they will be round and fall into three discrete sizes.***

***Avoid using gendered language to discuss animals. People tend to use “he” to describe things that are not obviously female, which tends to reinforce the false idea that “male” is the default gender, and “female” is other.***

***If students are confused about the relationship between warmth and growth you can use the analogy of baking. Things will cook really quickly at high temperature, and at low temperature they will still cook, but it will take longer. This is why Easy-Bake Ovens work even though they never get very hot***.

Temperature “Days” Sheet

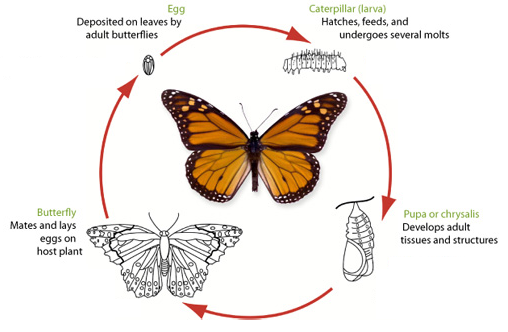
Cut along the lines. Mix all these temperatures up and select a volunteer to read off these temperatures for the insect growth part of the activity.

|  |  |  |  |
| --- | --- | --- | --- |
| **71** | **46** | **83** | **58** |
| **72** | **47** | **84** | **59** |
| **73** | **48** | **85** | **60** |
| **74** | **49** | **86** | **61** |
| **75** | **50** | **87** | **62** |
| **76** | **51** | **88** | **63** |
| **77** | **52** | **89** | **64** |
| **78** | **53** | **90** | **65** |
| **79** | **54** | **91** | **66** |
| **80** | **55** | **92** | **67** |
| **81** | **56** | **93** | **68** |
| **82** | **57** | **94** | **69** |
|  |  | **95** | **70** |

**Insect Growth Activity Worksheet** Date:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Name:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. How many “years” did you guess it would take for the “person” jar to grow up? \_\_\_\_\_\_\_\_
2. How many “years” did it take for the “person” jar to grow up? \_\_\_\_\_\_\_\_
3. If Tree 1 grows in a greenhouse and Tree 2 grows outside which will grow faster? \_\_\_\_\_\_\_\_
4. How many seasons did it take for the tree jar to grow up? \_\_\_\_\_\_\_\_
5. There weren’t any balls for spring or fall. If we had included them they should be:  
   A) bigger than the summer balls. B) medium-sized. C) smaller than the winter balls. \_\_\_\_\_\_\_\_

**Life Cycle of the Monarch Butterfly**

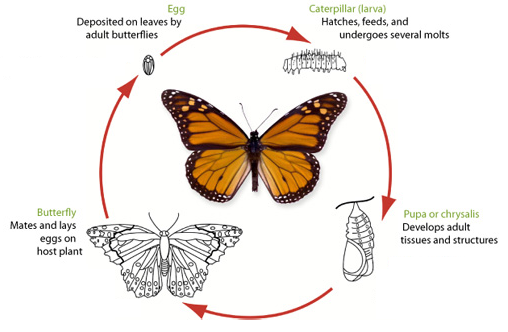
|  |  |  |  |
| --- | --- | --- | --- |
| Below 55° F | 55-65° F | 65-80° F | 80-95° F |
| Won’t Grow | Grows Slowly | Grows Normally | Grows Quickly |

1. How many days did it take for your monarch to develop to an adult? \_\_\_\_\_\_\_\_
2. Could a monarch that grew up in a different environment develop at a different rate? \_\_\_\_\_\_\_\_
3. Where would a monarch grow the fastest?  
   A) A jungle B) Your yard C) The North Pole. \_\_\_\_\_\_\_\_
4. Where would a monarch grow the slowest?  
   A) The beach B) your yard C) On top of a mountain. \_\_\_\_\_\_\_\_
5. When scientists measure insect growth they look at temperature (degrees) and time (days). What do they call these measurements? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Insect Growth Activity Worksheet Date:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Name:\_\_\_\_Answer Key\_

1. How many “years” did you guess it would take for the “person” jar to grow up? \_\_\_\_\_\_\_\_
2. How many “years” did it take for the “person” jar to grow up? \_\_\_\_\_\_\_\_
3. If Tree 1 grows in a greenhouse and Tree 2 grows outside which will grow faster? \_\_Tree 1\_
4. How many seasons did it take for the tree jar to grow up? \_\_\_\_\_\_\_\_
5. There weren’t any balls for spring or fall. If we had included them they should be:  
   A) bigger than the summer balls. B) medium-sized. C) smaller than the winter balls. \_\_\_B\_\_\_

**Life Cycle of the Monarch Butterfly**

|  |  |  |  |
| --- | --- | --- | --- |
| Below 55° F | 55-65° F | 65-80° F | 80-95° F |
| Won’t Grow | Grows Slowly | Grows Normally | Grows Quickly |

1. How many days did it take for your monarch to develop to an adult? \_\_\_\_\_\_\_\_
2. Could a monarch that grew up in a different environment develop at a different rate? \_\_\_Yes\_\_
3. Where would a monarch grow the fastest?  
   A) A jungle B) Your yard C) The North Pole. \_\_\_A\_\_\_\_
4. Where would a monarch grow the slowest?  
   A) The beach B) your yard C) On top of a mountain. \_\_\_C\_\_\_\_
5. When scientists measure insect growth they look at temperature (degrees) and time (days). What do they call these Measurements? \_\_\_\_\_\_Degree Days \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_