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

**Student Exploration:** **Measuring Motion**

**Vocabulary:** distance, speed

**Prior Knowledge Questions** (Do these BEFORE using the Gizmo.)

The **speed** of an animal is how fast it is moving. A speed of 6 m/s (meters per second) means that the animal moves a **distance** of 6 meters every second.

1. How would you measure the speed of an animal? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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1. What do you think are the fastest animals? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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**Gizmo Warm-up**

You have been sent on an African safari by *International Geography* magazine. Your assignment is to find the fastest land animals in the world. Your only tool is a video camera.

The safari is shown in the *Measuring Motion* Gizmo.

1. On the SAFARI ADVENTUREtab, wait for an animal to pass by. Press the **record** button ( recordbtn0002 ). Press **stop** ( recordbtn0003 ) when the animal has passed by.
   1. Which animal did you record? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
   2. Was the animal walking or running? \_\_\_\_\_\_\_\_\_\_\_\_
2. Select the PLAYBACKtab. Practice using some of the different buttons on this tab:

* Use the **Play** (button0003 ) button to replay the simulation.
* Click **Rewind** (button0001 ) to go back to the beginning.
* Click **Advance frame** (button0004 ) to move forward exactly one second at a time.
* Click **Tools** at upper left, and drag some **arrows** ( arrow ) onto the recording to mark the positions of the animals at different times.
* Use the **Time** slider to go to a specific time.

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| **Activity A:**  **Estimating speed** | Get the Gizmo ready:   * Select the SAFARI ADVENTUREtab. * Remove all **arrows** from the screen. * A calculator is recommended for this activity. | 660SE2 |

**Question: How do you measure speed?**

1. Run Gizmo: **Record** an animal running. Then switch to the PLAYBACKtab and watch your recording. Which animal did you record? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
2. Measure: Click **Rewind** (button0001 ). Use **Advance frame** (button0004 ) to advance the recording one second. Mark the animal’s position with an **arrow** ( arrow ) and repeat. Estimate the distance the animal traveled in one second. (Note: The trees in the background are 5 meters apart.)
   * 1. About how far did the animal travel in 1 second? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
     2. How did you make your estimate? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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1. Calculate: The distance an animal travels each second is its speed. What is the estimated speed of this animal? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ (Units are meters per second, or m/s.)
2. Measure: You can get a more accurate estimate of distance and time using these steps:

* Use the **Time** slider to position the animal so that its nose is even with the first tree. Record the current time in the table below as **Time 1**.
* Position the animal so that its nose is even with the last tree and record **Time 2**.
* Subtract the first time from the second to get the **Time difference**.
* Record the **Distance** from the first tree to the last. (The trees are 5 meters apart.)

|  |  |  |  |
| --- | --- | --- | --- |
| **Time 1** | **Time 2** | **Time difference (s)** | **Distance (m)** |
|  |  |  |  |

1. Calculate: The speed of the animal is equal to the distance divided by the time difference.
   * 1. What is the estimated speed of the animal now? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
     2. Is this value close to the speed you calculated before? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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| **Activity B:**  **Who’s fastest?** | Get the Gizmo ready:   * Select the SAFARI ADVENTUREtab. * Remove all **arrows** from the screen. * A calculator is recommended for this activity. | 660SE3 |

**Question: Which animal is the fastest?**

1. Form hypothesis: Watch the SAFARI ADVENTUREtab for a while. Based on your observations, which animals run the fastest? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
2. Measure: For each animal, measure distance traveled and time using any method you wish. Divide distance by time to calculate speed. Measure running animals only.

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| --- | --- | --- | --- | --- |
| **Animal/object** | | **Distance (m)** | **Time (s)** | **Speed (m/s)** |
| Cheetah | cheetah |  |  |  |
| Eagle | eagle |  |  |  |
| Elephant | Motion SE_2 |  |  |  |
| Gazelle | gazelle |  |  |  |
| Giraffe | giraffe |  |  |  |
| Jeep | Jeep |  |  |  |
| Lion | lion |  |  |  |
| Person | human |  |  |  |
| Rhino | rhino |  |  |  |
| Warthog | warthog |  |  |  |
| Zebra | zebra |  |  |  |

1. Analyze: What is the fastest animal/object? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Slowest? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
2. Convert: There are 1,000 meters in a kilometer, and 3,600 seconds in an hour. You can convert units of meters per second (m/s) into kilometers per hour (km/h) by multiplying by 3,600 and dividing by 1,000. (Hint: That is the same thing as multiplying by 3.6.)
   1. What is the speed of a cheetah in kilometers per hour? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
   2. What is the speed of a person in kilometers per hour? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_