SeaWorld/Busch Gardens

Physics

9-12 Classroom Activities

Physics of Jumping

OBJECTIVE

The student will determine jumping heights for various animals using a kinematic equation.

ACTION

1. Divide the class into groups of five.
2. Distribute a copy of the "Physics of Jumping" funsheet to each group. Explain to the class that the animals listed on the funsheet may jump straight into the air at varying heights. Whether an animal or human is jumping, the laws of physics apply.
3. The students will use the kinematic equation listed on the funsheet and the initial velocities to identify the average jumping heights for various animals.
4. Each student should select an initial velocity and insert it into the kinematic equation to determine the jumping height. Once all the heights have been determined, students will help correlate the answers with the animal heights given.
5. Instruct students to present their finding to the class. After all groups have presented their research, review the answers.

EQUATION AND SAMPLE PROBLEM

$V_f^2 = V_i^2 + 2a \times d$

V_f = The final velocity will always be 0 m/s (meters per second) because as the object reaches its peak height, it begins to slow down, finally reaching a 0 m/s velocity at the top.

a = Acceleration and is always equal to -9.8 m/s^2 for any free falling object

V_i = The initial velocity is specific to the animal and is listed on the individual equations.

d = how high the animal can jump which needs to be determined.

Example:

Dolphin = 16 ft.
16ft x 1 meter/3.3ft. = 4.8 meters

Given:

V_i=9.7 m/s

V_f=0 m/s (refer to above)

a = -9.8 m/s^2

Equation: $V_f^2 = V_i^2 + 2a \times d$

$(0\ m/s)^2 = (9.7\ m/s)^2 + 2(-9.8\ m/s^2) \times d$

$0\ m^2/s^2 = 94.09\ m^2/s^2 + -19.6\ m/s^2 \times d$

$0 - 94.09\ m^2/s^2 = -19.6\ m/s^2 \times d$

$$\frac{-94.09\ m^2/s^2}{-19.6\ m/s^2} = \frac{-19.6\ m/s^2}{-19.6\ m/s^2} \times d$$

d=4.8m

MATERIALS

Per student group:

- pencils
- "Physics of Jumping" funsheet

ANSWERS

Animal 1: armadillo 3.26 ft (0.99 m)

Animal 2: dolphin 15.84 ft (4.8m)

Animal 3: giraffe 6.7 ft (2.03 m)

Animal 4: serval 11.88 ft (3.6 m)

Animal 5: deer 8.02 ft (2.43 m)

Giraffes use their long legs to jump as far as 2 m (6.5 ft.).

Physics of Jumping Funsheet

Solve the following problems using the data given and the equation below.

Kinematic Equation: $V_f^2 = V_i^2 + 2a \times d$

Note: Equation will be in meters, but the answer must be converted to feet for animal identification. (3.3 feet equals 1 meter)

Animals: serval: 12 feet deer: 8 feet armadillo: 3 feet

giraffe: 6.5 feet dolphin: 16 feet

animal 1:

V_i=4.4 m/s

V_f=0 m/s

a = -9.8 m/s^2

answer _____feet

Which animal jumps this height?

animal 2:

V_i=9.7 m/s

V_f=0 m/s

a = -9.8 m/s^2

answer _____feet

Which animal jumps this height?

animal 3:

V_i=6.3 m/s

V_f=0 m/s

a = -9.8 m/s^2

answer _____feet

Which animal jumps this height?

animal 4:

V_i=8.4 m/s

V_f=0 m/s

a = -9.8 m/s^2

answer _____feet

Which animal jumps this height?

animal 5:

V_i=6.9 m/s

V_f=0 m/s

a = -9.8 m/s^2

answer _____feet

Which animal jumps this height?