**Catapults: Launching into Physics**

**Lesson 1: Golf Range Gizmo**

**Stem Grant Grade Band Team: 6-8A**

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**Key Terms:**

**Math**:Angle

**Science**: Gravity, force, distance, acceleration, and velocity

**Learning Objectives:**

Students will be able to:

1. experiment with different combinations of velocity and launch angle of projectile.

2. draw velocity vectors.

**WMAS Science**

**D.8.5** While conducting investigations, explain the motion of objects by describing the forces acting on them.

**D.8.6** While conducting investigations, explain the motion of objects using concepts of speed, velocity, acceleration, friction, momentum, and changes over time, among others, and apply these concepts and explanations to real-life situations outside the classroom.

**Career Cluster Pathways in Manufacturing**

Manufacturing, Production Process Development and Quality Assurance

**Materials:**

Computer with Internet access

Gizmo license

Student Exploration (1 per student)

**Procedures:**

1. Take students outside and appoint a “thrower” and a “catcher.” The remaining students should stand off to the side so they can observe the trajectories of the balls.

2. Have the thrower throw the ball as hard as possible at increasingly higher angles. Ask the remaining students to sketch the trajectories of each throw and record the distance of each throw on paper.

3. Discuss the forces acting on the ball in the horizontal and vertical directions. At which angle did the ball travel the farthest? What are the shapes of the trajectories of the balls?

4. Travel back to the classroom.

5. Hand out Student Exploration worksheet

6. Have students complete the Prior Knowledge questions (1 and 2)

7. As a class, discuss the answers to the Prior Knowledge questions

8. Have students go to http://www.explorelearning.com and log in

9. Go to class and select Golf Range Gizmo

10. Follow directions in the Gizmo Warm Up individually

11. When finished, do Activity A and answer questions 1 and 2

12. Complete the vector diagrams - If not finished in class, it is homework for the following day

**Assessment:**

**Pre-assessment**

Students will be asked prior knowledge questions.

**Formative assessment**

Students will answer the questions provided with the Gizmo while completing the Gizmo.

**Post-assessment**

Students will complete the vector diagrams at the end of the handout.

**Reflection on REACT:**

1. **Relating:**
Students will use the Gizmo to relate use of forces with everyday activities.

1. **Experiencing**:
Before the lesson students will learn the key concepts in the lesson, such as force, motion, velocity, surface area, circumference, and measuring angles to name some. They will also research and construct a catapult that will be used in this lesson. During the lesson students will use the before mentioned skills to make a hole-in-one. After the lesson they will show understanding by creating a catapult that launches a ball to a designated area.
2. **Applying**:
Students will take their knowledge to make a hole-in-one, to design and build a catapult, and have the catapult launch at a target.
3. **Cooperating**:
Students will take what they have learned and collaborate with group members to create a catapult that launches accurately.

1. **Transferring:**
Students will take the concepts of gravity, force, distance, acceleration, and velocity to make a hole-in-one and then transfer that knowledge to create a catapult that will launch and place a ball on the target.

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**Student Exploration: Golf Range**

**Vocabulary:** Gravity, force, distance, acceleration, and velocity

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

1. You are in a contest with your friends to see who can drive a golf ball the farthest. Should you hit a “line drive” (low to the ground) or a shot with a very high angle? Explain.

1. Golf drives travel much farther than Major League home runs. Why might this be?

**Gizmo Warm-up**

Have you ever hit a hole-in-one? You will have a chance to do that in the *Golf Range* Gizmo™, where you will see how a variety of factors affect the path of a golf ball. The movement of objects such as a ball through space is called **projectile motion**.

1. Press **Play** (). Did the ball go too far, the right distance, or not far enough?

1. Click **Reset** (). Move the **vinitial** and **θ** sliders to adjust the **velocity** and **launch angle** until you get a hole-in-one. (With the Gizmo sound on () you will hear “Hole in one!”)

 What were the velocity and launch angle values?

1. Can you get holes-in-one using other combinations of **vinitial** and **θ**? If so, give an example.

|  |  |  |
| --- | --- | --- |
| **Activity A:** **Maximum distance** | Get the Gizmo ready: * Click **Reset** and check that **Atmosphere: Air** is selected.
* Set ***vinitial*** to 75 m/s and ***θ*** to 45.0 degrees.
 | GolfRangeSE2 |

**Question: What launch angle will produce the longest drive?**

1. Form hypothesis: What launch angle do you think will yield the longest drive?

1. Experiment: Turn on the **Show grid** checkbox. With the velocity set to 75 m/s, experiment with a variety of launch angles until you find the one that yields the longest driving distance.
2. What launch angle produced the longest drive?
3. How far did the ball travel?

**Vector Diagrams**

Directions: Draw and label the forces acting on the golf ball.

 **At Rest Contact with Club**



** Rolling on the Green Golf ball in the hole!**