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| **TEXAS CTE LESSON PLAN**[www.txcte.org](http://www.txcte.org) |
| **Lesson Identification and TEKS Addressed** |
| **Career Cluster** | Science, Technology, Engineering, and Mathematics |
| **Course Name** | Engineering Design and Problem Solving |
| **Lesson/Unit Title** | Engineering Design Mini Project |
| **TEKS Student Expectations** | **130.412. (c) Knowledge and skills**(5) The student applies knowledge of science and mathematics and the tools of technology to solve engineering design problems. The student is expected to:(A) apply scientific processes and concepts outlined in the Texas essential knowledge and skills (TEKS) for Biology, Chemistry, or Physics relevant to engineering design problems(F) investigate and apply relevant chemical, mechanical, biological, electrical, and physical properties of materials to engineering design problems(I) make measurements with accuracy and precision and specify tolerances(6) The student communicates through written documents, presentations, and graphic representations using the tools and techniques of professional engineers. The student is expected to:(A) communicate visually by sketching and creating technical drawings using established engineering graphic tools, techniques, and standards(9) The student manages an engineering design project. The student is expected to:(I) maintain an engineering notebook that chronicles work such as ideas, concepts, inventions, sketches, and experiments |
| **Basic Direct Teach Lesson**(Includes Special Education Modifications/Accommodations and one English Language Proficiency Standards (ELPS) Strategy) |
| **Instructional Objectives** | Students will be able to:* Review scientific concepts of kinetic energy, potential energy, and energy transfer,
* Determine the coefficient of restitution (COR) for various sports balls,
* Understand elastic and inelastic collisions,
* Practice sketching and creating technical drawings of various sports balls using graphic tools,
* Apply the concept of engineering design to a problem scenario, and
* Reinforce collaborative and communication skills.
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| **Rationale** | After completing this lesson, students will be able to explain the concept of engineering design, apply engineering design concepts to a problem scenario, practice sketching technical drawings in their engineering notebooks, and reinforce collaborative and communication skills. |
| **Duration of Lesson** | The lesson plan will take 8 class periods. |
| **Word Wall/Key Vocabulary***(ELPS c1a, c, f; c2b; c3a, b, d; c4c; c5b) PDAS II (5)* |  |
| **Materials/Specialized Equipment Needed** | * Engineering notebook
* Team contract document
* Pen and pencil
* Graph paper
* Compass/protractor
* Various sports balls, of different shapes, sizes, materials, and age (e.g., new golf ball and used golf ball)
* Meter stick
* Balance (to explore relationship between mass and energy for extension applications)
* Random measurement equipment (so that they must figure out what they really need to use), timers, graduated cylinders, balances, forces, scales, etc.
* Computer
* Overhead Projector
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| **Anticipatory Set**(May include pre-assessment for prior knowledge) | * **SAY:** It’s the beginning of the school year.You are interested in joining an extracurricularsporting team. There are several female and male sporting teams to choose from at the high school. What are the sporting teams at your high school? Research and list the various types of extracurricular sporting teams available for both female and male students. Gather the types of balls used for each extracurricular sporting team. Students will discuss what might happen if you tried to use the “wrong” ball for a sport.
* **ASK:** What might happen if you tried to usethe “wrong”ball for a sport?
* **SAY:** Today we are going to learn about the concept of coefficient of restitution (COR) andsketching and technical drawing in this mini project.
* **MAKE:** Intro Mini Project PowerPoint presentation. (Instructors are encouraged to make a PowerPoint presentation in conjunction with the following lesson outline).
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| **Direct Instruction \*** | Outline | Instructor Notes |
| I. Intro-Mini Project PowerPoint PresentationA. IntroductionB. Schedule of AssignmentsC. Introduction/Course DescriptionD. VocabularyE. O\*Net [(www.onetonline.org](http://www.onetonline.org/))F. Team Building ReviewII. Student Activity – Part 1 A. Answer questions from previous day for clarificationB. Review student scenario and student project basics slidesC. Assign teams and have students complete team contractD. Gather sports balls (Step 1)E. Introduce assignment rubricF. Determine the COR for 5 sports balls, putting data collection information in engineering notebooksIII. Student Activity – Part 2A. Discuss Mini Project data collectedB. Create PPT presentation with information required for presentation to other class membersIV. Student Presentations A. Students present their group presentations to classB. Questions to Consider | * PPT presentation – 2 days (45 minutes per day)
* Introduction & O\*Net
* ([www.onetonline.org](http://www.onetonline.org))
* Schedule of Assignments
* Objectives
* Driving Questions
* Vocabulary
* Content, Coefficient of Restitution YouTube video, The Bounce of the Ball article
* Project Team Protocol, including team member roles
* Activity – 2 days (45 minutes per day) – Determine COR of sports balls selected
* Activity – 5 days (45 minutes per day)
* Create PPT presentation
* Team Presentations
* Required Materials:
* Team Contract Spreadsheets (one per team)
* Required Materials:
* Lab materials
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| **Guided Practice \*** | Teacher will observe student teams as they work on the coefficient of restitution (COR) experiments, sketching, technical drawing, and Microsoft PowerPoint presentation tasks.Individualized Education Plan (IEP) for all special education students must be followed. Examples of accommodations may include, but are not limited to:NONE |
| **Independent Practice/Laboratory Experience/Differentiated Activities \*** | Have student teams evaluate everyone's Microsoft PowerPoint presentation and explain what they would change on their presentation next time.Individualized Education Plan (IEP) for all special education students must be followed. Examples of accommodations may include, but are not limited to:NONE |
| **Lesson Closure** | * **Question:** Why different balls might be used for different sports?
* **Answer:** Answers will vary.
* **Question:** What is the coefficient of restitution (COR) of the various sporting balls?
* **Question:** What are the female and male sporting teams at your high school?
* **Question:** What are the types of sporting balls used by the female and male students?

Individualized Education Plan (IEP) for all special education students must be followed. Examples of accommodations may include, but are not limited to:NONE |
| **Summative/End of Lesson Assessment \***  | **Informal Assessment:**The teacher will observe the students as they complete the coefficient of restitution (COR), sketching, technical drawing, and deliver their Microsoft PowerPoint presentations. Look for teamwork and professionalism.**Formal Assessment:*** Establish project team protocol, roles, and complete team contract spreadsheet.
* Complete tasks listed on team contract, including the sketches and technical drawings of the sports balls.
* Deliver team’s Microsoft PowerPoint presentation.

Individualized Education Plan (IEP) for all special education students must be followed. Examples of accommodations may include, but are not limited to:NONE |
| **References/Resources/****Teacher Preparation** | * Understand that students need to be creative with this lesson. Allow student teams to complete the contract spreadsheet and assign roles. Discuss the “Coefficient of Restitution” YouTube video and “The Bounce of the Ball” article (handout). Provide the students with the following materials: various sport balls, meter sticks, balance, timers, pencil, graph paper, graphing tools, and engineering notebooks. There is also a Team Contract Spreadsheet that can be used on the last page of the lesson plan.
* Roller Coaster <http://en.wikipedia.org/wiki/Kinetic_energy>
* Bouncing Ball

[http://en.wikipedia.org/wiki/File:Bouncing\_ball\_strobe\_edit.jpg](http://en.wikipedia.org/wiki/File%3ABouncing_ball_strobe_edit.jpg) |
| **Additional Required Components** |
| **English Language Proficiency Standards (ELPS) Strategies** |  |
| **College and Career Readiness Connection[[1]](#footnote-1)** |  |
| **Recommended Strategies** |
| **Reading Strategies** |  |
| **Quotes** |  |
| **Multimedia/Visual Strategy****Presentation Slides + One Additional Technology Connection** | * “Coefficient of Restitution” YouTube video: from YouTube user; Gaby Salguero [(http://www.youtube.com/watch?v=0bis1cA842c](http://www.youtube.com/watch?v=0bis1cA842c)); Screen 19
* The “Bounce of the Ball” article:

[(http://www.physics.usyd.edu.au/~cross/PUBLICATIONS/BallBounce.pdf](http://www.physics.usyd.edu.au/~cross/PUBLICATIONS/BallBounce.pdf)), Screen 21 |
| **Graphic Organizers/Handout** | * Engineering Mini Project Team Contract
* Engineering Mini Project Vocabulary Handout
* Engineering Mini Project Rubric
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| **Writing Strategies****Journal Entries + 1 Additional Writing Strategy** |  |
| **Communication****90 Second Speech Topics** |  |
| **Other Essential Lesson Components** |
| **Enrichment Activity**(e.g., homework assignment) | Students could produce a formal write-up, including reflection questions, asking them to apply what they’ve learned about the correlation of restitution (COR). |
| **Family/Community Connection** |  |
| **CTSO connection(s)** | SkillsUSATechnology Student Association |
| **Service Learning Projects** |  |
| **Lesson Notes** |  |

1. Visit the Texas College and Career Readiness Standards at <http://www.thecb.state.tx.us/collegereadiness/CRS.pdf>, Texas Higher Education Coordinating Board (THECB), 2009. [↑](#footnote-ref-1)