**SCIENCE EXPLORE LESSON PLAN**

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| **Lesson Plan Background** | | | |
| **Teacher: Wackerman** | | **Date: 11/17/15** | |
| **Course:** Physics | | **Unit Title: Balanced Forces** | |
| **Objective** | | | |
| **Skills/Content:** *By the end of today’s lesson, what will students know and be able to do?*  SWBAT Evaluate the interaction relationship of the forces between two different objects | **Assessment:** *How will students demonstrate mastery of the objective?*  Exit Slip- open response questions about the core idea “the force between two objects in an interaction will always be equal and opposite” | | **Criteria for Success:** *What are the features of an ideal product?*   * Correctly completed explore page * ET answers that associate forces between objects as equal and opposite |
| **Other Lesson Plan Considerations** | | | |
| **Key Conceptual Understandings:** *What key ideas do students need to take away from today’s lesson?*   * Forces always happen in pairs. If a force occurs on one object, it also occurs on another. * Whenever 2 objects interact, the amount of force between them will always be equal and opposite * The interaction between two objects is entirely separate from our discoveries about how forces cause a given object to act | | | |

| **Lesson Plan Components** | | | | | |
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| **Time** | **Component** | **Detailed Explanation of Components**  ***(What is the teacher doing? What are the students doing?)*** | | | |
|  | **Planning** | **Planning Part I: Scripting the Key Understanding** | | | |
| **Part 1 (today’s Lesson)**   * Forces always happen in pairs. If a force occurs on one object, it also occurs on another. * Whenever 2 objects interact, the amount of force between them will always be equal and opposite | | | |
| **Planning Part II: The Activity** | | | |
| **Activity:**  Students follow a handout in which they will complete three rounds of data collection regarding how much force each object gives and receives in a force interaction. They will work in pairs when collecting and analyzing data.  **Data gathered and analyzed:**  Round 1: 2 carts on a Vernier track, with plastic flexible tubing. Carts collide and students observe that no matter the collision pattern, both carts appear to intake the same amount of force.  Round 2: Pairs receive spring scales, and then push and pull against each other constantly, and determine that the force on both objects is equal and opposite.  Round 3: 2 new Vernier carts, with force sensors, students observe that also during collisions the force on the two objects is always equal and opposite. | | | |
|  | **Start of Class**  **15 min/7 min total** | **ENTRY [6 min]:**  Students enter according to UPC physics classroom 1st 5 procedures. Teacher circulates to insure expectations met and monitor Do Now for common errors or misconceptions.  **Do Now Task (to be completed during entry procedure):**  **Vocab Quiz**  **REVIEW DO NOW [0 min]**  **PREPWORK REVIEW & TURN IN [0 min]:** | | | |
|  | **1**  **Frame**  **12 min / 19 min total** | **FRAME THE ACTIVITY [5 mins]**  Today we will be exploring a brand new concept. You will see some demonstrations as a whole class, and you will have some time to experiment with some hands on materials.  The question we are asking today is “How does the force between two objects compare to each other?”  In the space provided, please take 45 seconds to brainstorm some factors that might affect the amount of force between two objects.  (object’s mass, velocity, push/pull, duration of force)  Before we begin, it is extremely important to clarify one piece. For the last 2 weeks we have been learning all the ins and outs of how forces may affect a single object. We have learned that the forces on a single object may be balanced or unbalanced, and then a lot of information on top of that.  Today’s lesson is different. Today we are asking “How does the force between two objects compare to each other?”  So this is not about what happens to either object, it is about how the forces between them compare.  Lets begin. | | | |
|  | **2**  **Data Gathering and Analysis**  **25 min / 44 min total** | **Independent Work Time: [7 mins]** | | | |
| **Round 1:**  Open your packet to the page that says Round 1, with a series of charts to fill out. Round 1 will be whole class demonstrations. Up front are two carts. One is 1kg, the other is .5kg. Both have a plastic tubing attached. When they collide, you will see the tubing bend. Pay attention to which bends more in each situation, as this will reflect which one has more force.  First. Predict which you believe will have more force when the two cars collide together at similar speeds.  *Demo.* Change your answer or justify it.  Second. Predict which you believe will have more force when the heavier cart is moving fast and the light cart is still.  *Demo.* Change your answer or justify it.  Third. Predict which you believe will have more force when the lighter cart is moving fast and the heavy cart is still.  *Demo.* Change your answer or justify it.  Devise some theories based on what you saw.  Do you believe mass affects the force between two objects?  Do you believe velocity affects the force between two objects?  **Round 2:**  Turn in your packet to Round 2. Round 2 will be partner work. You and your partner will receive 2 spring scales.  Before this happens, let’s do some short practice on how to properly read a spring scale  Okay, now you have your spring scales. The page lists very specific tests to run, but let’s do the first one together. Let’s start by pulling. Partner 1, pull until your scale reads 5 N. Partner 2, read your scale.  The next trials ask you to try pushing the scales instead of pulling. Take 5 minutes to work with your partner and complete the questions in Round 2.  All of these trials were constant force. Consider all the tests you just ran, and devise a theory about the amount of force between two objects.  **Round 3:**  Round 3 is again whole class. This time, our carts are equipped with Force sensors. We’ve developed a theory about the force between two objects when that force is being applied constantly, now let’s investigate the force between two objects when the force is an instantaneous collision.  First. Predict which you believe will have more force when the two cars collide together at similar speeds.  *Demo.* Change your answer or justify it.  Second. Predict which you believe will have more force when the heavier cart is moving fast and the light cart is still.  *Demo.* Change your answer or justify it.  Third. Predict which you believe will have more force when the lighter cart is moving fast and the heavy cart is still.  *Demo.* Change your answer or justify it. | | | |
| **Whole Class Discussion:** | | | |
| **Turn-and-Talk/Drive toward the Stamp:**  How many instances, in round 2 or 3, has the force between the two objects been different?  Make a statement about the magnitude of the two forces  Make a statement about the direction of the two forces | | | |
|  | **3**  **Whole Class Discussion**  **(10 min.)** |
|  | **4**  **Stamp the Key Under-standing**  **(5 min.)** | **Name the rule:**  Forces always happen in pairs. Whenever there is one force, there is always another equal and opposite force. | | | |
|  | **5**  **Apply Key Under-**  **Standing**  **(10 min.)** | **Exemplar Response** | | | |
| **The apply section will occur next class. Below is the tentative plan of activities for the next class:**  DN Balanced forces on motion graphs  Hook mythbusters video 2 cars crashing into each other  Apply practice of 3rd law problems  Clarification of “balanced” vs “equal and opposite”  Apply practice differentiating 3rd law and 1st law problems  Exit Slip  IP time to work on Quiz Review Guide  **Before this lesson is complete, the GP HSILT will be completed for the following day, such that the apply definitely complies with the key understanding from the investigation.** | | | |
| **Actionable Feedback Key** | | | |
| *Insert Codes for Actionable Feedback that you will write on student papers. Plan to write these on student papers & briefly explain the error that needs to be fixed.* | | | |
| **Classroom Data** | | | |
| *Circulate from High to Medium to Low Students. Use tally marks or student initials to record who has/ has not mastered.* | | | |
| ***Mastered*** | ***Not Mastered*** | | ***Common Errors*** |
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| **Response to Data:** *Plan how to react if…* | | | |
| **Most have it right (<70%)** | **Around half have it right (50-70%)** | | **Most don’t have it right (<50%)** |
| Check in with students individually | Stop verbally and refer students to use the previous two pages and their conclusions about CV to guide their answers | | Stop the show and return to show call. CC students about when objects have Fnet=0N and what that means they are doing. |
| **Student Support Planning** | | | |
| **Students to Guide First** | | **Prompts/Questions** | |
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