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| **Lesson Plan** |

Name of Teacher: Jie Ma Date: 11/18 Course: Physics

Unit: Unit 4. Dynamics: Force and Newton’s law of motion Topic： Unit 4. 4 Newton’s 3rd law of motion

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| CA State Standard:  HS-PS2-1.  Analyze data to support the claim that Newton’s second law of motion describes the mathematical relationship among the net force on a macroscopic object, its mass, and its acceleration. |

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| Lesson Objective:   * Students will be able to create free body diagrams and analyze the interactions between objects and forces * The student is able to construct explanations of physical situations involving the interaction of bodies using Newton's third law and the representation of action-reaction pairs of force. |

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| Materials:   * Skateboards, rolling chairs, air balloons, computer and TV. |

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| Anticipatory Set:   * Newton’s law of motion is commonly observed in our daily life. Students will find similarity between different daily events and summarize their findings use academic language. * Start with what the students already know and start with reviewing old concepts, newton’s 1st law. Students would see the connection between this lesson and the past lesson. |

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| Communicate the Objective and Purpose:  *T: Today we will continue our discussion on Newton’s law. We have learned newton’s 1st law and 2nd law. Can you state what are they?”*  S: (maybe, “First law, object in motion will sate in motion, object at rest, will stay at rest” “F = ma”  T: Ask a question, see slide 52. And show students the learning objective for today.  T: Newton’s 1st law and 2nd law is about one object(system)’s reaction of force. Today we will explore the interaction between two systems. And the law that governing the interaction. First, we will start our lesson with several demonstrations, and pay attention to the direction and magnitude of forces. Second, we will learn the description of Newton’s first law using academic language. Third, we will do some conceptual questions about newton’3rd law. You would have homework on that about Newton’s third law. From tomorrow, we will start integrating two concepts, Newton’s law and kinematics. |

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| Instruction & Modeling:  **Part 0: Newton’s 1st law review:**   * A slight pull **Fp** is exerted on a box. Not enough to move it. A force of friction f now acts,   + Which is   + a. (less than) b. (equal to) c. (greater than) Fp   + Net force on the cart is d. (zero) e. (greater than zero)   Since the object is not moving, this is a static friction. So Fp = f and the net force is zero.  (ask students to write down their answers on the white board)  **Part 1: Explore, explore the law governing two system interaction through observation.**  **Key Skill: 3. Planning and carrying out investigations**  Demo 1: a student no the skateboard and push the wall, the wall push him back.  Demo 2: every student (on the rolling chair) push the table and they would move to the opposite direction.  Demo 3: blow up air balloon. Ask students to predict the direction of the balloon is going.  If I push the table harder, the table push with larger force, they will feel larger reaction force.  **Part 2: Explain: Explain daily phenomena using Newton 3rd law.**  State Newton’s 3rd law: Whenever one body exerts a force on a second body, the first body experiences a force that is **equal** in magnitude and **opposite** in direction to the force that it exerts.  Review the meaning of magnitude, show free body diagram for Newton 3rd law.  Image result for newton 3rd law free body diagram  Conceptual question check (ask students to discuss among groups and ask by cold call)   * When a hammer exerts a force on a nail, how does the amount of force compare with that of the nail on the hammer? (the forces are the same, because they are action and reaction forces) * What is wrong with the following statement: When you exert a force on a baseball, the equal and opposite force on the ball balances the original force and therefore, the ball will not accelerate in any direction?   (action force and reaction force act on two different body, although they have same magnitude and opposite direction, they would not be able to balance out)   * Tom is pulling upon a rope that is attached to a wall. In the next picture, Tom is pulling upon a rope that is attached to an elephant. In each case, the force scale reads 500 Newton. In which picture, does Tom apply the more force?   (The forces are the same, because the scale shows how much force is acting on the string, since the readings are the same, the forces acting on the string are string are the same, so as the reaction force, the pulling force are the same (tension)    Students to write on the white board by pair     * + 1. The **elephant's** feet push backward on the **ground**; the ground pushes forward on its feet.     2. The right end of the right **rope** pulls leftward on the **elephant's** body;   its body pulls rightward on the right end of the right rope.   * + 1. The left end of the right **rope** pulls rightward on the **man**; the man pulls leftward on the left end of the right rope.     2. The right end of the left **rope** pulls leftward on the **man**; the man pulls rightward on the right end of the left rope.     3. The **tractor** pulls leftward on the left end of the left **rope**; the left end of the left **rope** pulls rightward on the **tractor**.     4. The tractor pushes forward on the ground; the ground push backward on the car.   Part 3: Elaborate: Symmetry in nature. Interaction with people (See part D)  Part 4: Kahoot |

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| Integration of Scripture and School ESLR:  Inspiration from physics law.   * For every interaction between things, there is always a pair of oppositely directed forces that are equal in strength. If you push hard on the world, for example, the world pushes hard on you. If you touch the world gently, the world will touch you gently in return. The way you touch others is the way others touch you.   As a result, we need to be compassionate. When we are nice to others, others will be nice to you. We need to see life from other’s point of view. |

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| Guided Practice:   1. Sampling: Posing questions to whole group, then getting answers from representative members. Each group will write their answer on the white board. Students will be cold called to answer the questions. |

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| Independent Practice:   1. Individual Private Response: Each student is accountable. Homework are assigned and collected during class. 2. Kahoot questions. Teach would see individual response 3. Homework |

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| Differentiated Learning (for II-Instructional Input,  GP-Guided Practice, and/or IP-Independent Practice): | | | |
| ELL Learners  Lesson slides post ahead of time | RSP  Guided questions post on Schoology ahead of time. Answers will be written on the board. Students can take pictures. | GATE  Individual  in class practice (Kahoot)  Homework time in class, teacher could check induvial response | Other  Students with IEP have more time to do homework |

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| Closure (recap of critical attributes):  Review the lesson objective. Newton’s 3rd law. Action force equal to the reaction force. |

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| Contingency Plans:  Practice graph using excel. Individual help on lab report. |

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| Self-Reflection & Feedback: |