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| **Common Issues** | **Suggested Questions or Prompts**  Forces & Motion Concept Development, *alpha v.* |
| Student thinks that other concepts are forces when they are not, such as: momentum, inertia, speed, kinetic (or some other kind of) energy… | What is a force? (push or pull) Is “momentum” a push or a pull? How does “momentum” apply a push or a pull to the object?  What are the units for force? What are the units for “momentum?” (this may not be effective if the student does not understand units for the concept they are confused about) |
| Student thinks that **after** a shove or a throw then there is still a force acting on the object from the shove or throw. | Does there need to be contact for a force to be exerted? Under what conditions do forces affect objects when there is not contact? (Unless gravity or magnetism is causing the force, then there must be contact for a force to be applied.)  So if there is no contact after the box is shoved, then does the shove exert a force on the box? (no. The shove increases the box’s speed and momentum, but if there is no contact then there is not a force acting from the shove.) |
| Student does not understand that air resistance exerts a force on falling objects and/or doesn’t understand the relative magnitude of the force due to gravity and the force due to air resistance on *most* objects. | Ask students to imagine (or test) a flat piece of paper as it is falling and the same paper crumpled into a ball and is falling. What are the forces acting on the paper in each situation? Why does the paper fall at different rates? Draw force diagrams for the paper in each situation with the forces drawn at appropriate lengths to represent their magnitude. |
| Student believes that if the forces acting on an object are balanced then the object cannot be moving. Student does not understand that an object with forces balanced can be in motion and that the motion is constant speed. Student does not recognize that zero speed is a constant speed of zero. | Consider a box moving across a table at constant speed due to a push. Identify the forces acting on the box in the “x” direction. (force due to the push and the opposing force due to friction between the box and table surface) Which force is bigger, the push or friction? (at constant speed they are equal (and balanced) but students frequently say that friction is less than the push, which is why the box moves, even if at constant speed) Then are these forces balanced or not balanced? (if student says friction is less, then the student would conclude that the forces are not balanced) If the forces are not balanced then how would the box move? (it would accelerate and not be at constant speed) So what can you conclude about the relative strengths/magnitudes of the push and friction for a box moving at constant speed as it slides across a table due to a push? What would you say about each of these forces if the surface of the table changed, say to something very smooth or very rough, but the box was still moving at constant speed? (the push and friction force would be less for a smooth surface and more for a rough surface, but the push and the friction force would still be equal if the speed is constant.) |
| Student does not understand how the force diagram models the box on the table and/or how this force diagram can be used to evaluate the effect of the forces that could act on the box. | Show student the picture of the box on the table and the force diagram to review – make sure student has a clear understanding of the model. When the box is at rest, what forces are acting on the box? Are these forces balanced? What is the motion of the box? Now look at the force diagram. Look at the length of the force arrows? What do you notice? Do you think this represents forces that are balanced? Does this model make sense? If I push on the box, what new forces would need to be added to the model? |