Forces Modeling Norms

Mi-STAR
Michigan Science Teaching
and Assessment Reform

All Force Models should include:

Title	Labels for objects and forces	*System Boundaries (dashed line)

* System boundaries (dashed lines) are provided in diagrams so students will become accustomed to seeing and using them. Students are NOT required to identify system boundaries independently.

Rules for All Forces:

Forces are represented as arrows called vectors.
The length of the vector shows the magnitude of the force. (big, small, medium - no numbers or units ... yet.)
The vector starts at a point and shows the direction of the force.
Draw only one vector for each force.
Label each force like this: $F_{a \text{ on } b}$, where **a** is the object pushing (or pulling) on object **b**. Examples: $F_{\text{wall on hand}}$ or $F_{\text{hand on wall}}$

Two Object Model for analyzing the forces between TWO interacting objects:

Show point of contact (near the middle if the point of contact is a surface) with a dot. Use **red**.
At contact point between two objects there are force pairs that are ALWAYS equal in size and oppositely directed. Show these with vectors of equal size pointing in the opposite directions.   Remember, *"Red vectors need buddies"*
Force pairs are shown in **red**.

One Object Model to analyze Balanced/Unbalanced Forces on ONE object:

The dot should go in the center of the one object. Use **green**.
Green arrows represent the force vectors. Show a vector for each individual force acting on the object.
The sum of **balanced** forces on an object is zero. (Lengths of vectors will be equal but in opposite directions) If this is the case there is no CHANGE in motion, BUT there may be motion in a straight line and not speeding up or slowing down.
The sum of **unbalanced** forces on an object is not zero. If this is the case, there must be a change in motion (speeding up or slowing down) OR a change in shape (crushing or bending). Remember, *"Green vectors don't always need buddies"*. Usually we only show one arrow, the sum of the forces, which indicates the direction of the motion change.

NEVER analyze One Object (red) and Two Object (green) together on the same diagram or model. Use one or the other depending on what we need to know about forces. For example, if we want to know how one object is applying a force to another, use the Two Object model. And if we want to know if/how an object's motion will change, use the One Object model.