

getting the physics straight

to build a force-centric view of the world is to engage in radical

forces are exerted by the object's environment

resultant forces change motion

forces act on an object

forces are vectors

forces replace interactions

representing the topic effectively

isolate object and replace physical interactions with arrows

arrow as vector

consistent and helpful conventions for drawing forces

particular teaching challenges

replaces a complex interaction with a simple arrow

how to settle on a correct set of arrows with children / colleagues

explicit development of a model

establishing reasoned drawing conventions

identifying forces is an opaque process

arrows with no labels

placing arrows by rote

too many arrows

just guessing about arrows

dealing with existing ideas

forces associated only with animate objects

no forces on stationary objects

moving objects carry a force

conflating force and energy

changes in motion depending on inherent properties of objects

'friction' used indiscriminately

selected teaching principles

free body diagrams as structured drawings for a purpose

rationale for placement of arrow - a long or short story

teaching reasons for ontology

giving an explanation as telling a story - moving from one description