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
- kinematics as a powerful descriptive apparatus
- the role of symmetry in arguments

particular teaching challenges

- replace a complex interaction with a force-pair
- resultant force changes motion
- measuring velocity
- establishing reasoned drawing conventions
- too much reliance on shortcuts
- 'formula hunting' without understanding
- what's empirical and what's not

dealing with existing ideas

- force changes motion
- average and instantaneous speeds are often conflated
- relative motion can lead to confusion

representing the topic effectively

- isolate object and replace physical interactions with arrows
- specific arrows for different vector quantities
- power in pathways accumulating energy in stores
- force acting accumulating momentum
- acceleration accumulating velocity; velocity accumulating displacement

selected teaching principles

- free body diagrams as structured drawings for a purpose
- interaction diagrams as structured drawings for a purpose
- starting with Newton 3, or with isolated masses
- a clear description of motion: diagrammatic, graphical, algebraic
- making the status of Newton's three laws clear
- explicit construction of functional models of the lived-in world