MODELING INSTRUCTION
in
HIGH SCHOOL PHYSICS
Teacher s Guide
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2002

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STUDENT MATERIALS - Motion Maps
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UNIT III: PARTICLE UNDERGOING UNIFORM ACCELERATION
Objects in Linear Translation with Constant Acceleration

INSTRUCTIONAL GOALS
- Average vs instantaneous rate of change: the case of velocity
- Acceleration vs. velocity
- What is a Constant Force Particle (CFP)? What is its domain?
- CFP s kinematical properties and laws of motion
- Motion map
- Multiple representations (graphical, algebraic, diagrammatic)
- Free fall

LAB NOTES & INSTRUCTIONAL COMMENTS:
- Inclined rail lab, Free fall with picket fence

DEPLOYMENT EXERCISES
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DYNAMICS: EXPLANATORY PARTICLE MODELS

UNIT IV: FREE PARTICLE MODEL
Inertia and interactions

INSTRUCTIONAL GOALS
- Newton's 1st law (Galileo's thought experiment)
- Inertial reference frames
- Interaction and force
- Newton's 3rd law
- Superposition principle
- FP s dynamical property, force diagrams and motion maps
- Statics: equilibrium of a particle

LAB NOTES & INSTRUCTIONAL COMMENTS:
- Dry ice, the normal force, weight vs mass, statics, paired forces,

STUDENT MATERIALS - Force diagrams
DEPLOYMENT EXERCISES
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SUPPLEMENTARY MATERIALS
- Trigonometric approach to vector analysis
- Spreadsheets and vector analysis

UNIT V: CONSTANT FORCE PARTICLE MODEL
Force as Cause of Acceleration in Linear Translation

INSTRUCTIONAL GOALS
- Newton's 2nd law
- CFP s dynamical properties, force diagrams and motion maps
- Friction
- Modeling in paradigm problems

LAB NOTES & INSTRUCTIONAL COMMENTS:
- Modified Atwood's Machine Lab, Friction Lab

STUDENT MATERIALS - Types of friction
DEPLOYMENT EXERCISES
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UNIT VI: PARTICLE MODELS IN TWO DIMENSIONS
Describing and Explaining Translation in a Plane by Combining FP and One-Dimensional CFP models

INSTRUCTIONAL GOALS
- Superposition principle
- FP in different inertial reference systems (FP + FP)
- CFP in a non-inertial reference system (CFP + CFP)
- CFP in different inertial reference systems (CFP + FP)
- Application of CFP in two dimensions: the case of a projectile
- Kinematical and dynamical properties, force diagrams and motion maps

LAB NOTES & INSTRUCTIONAL COMMENTS: Behavior of a Projectile
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UNIT VII: ENERGY
Explaining Particle Translation via Conservation of Energy

INSTRUCTIONAL GOALS
- Revisit paradigm labs- view from energy perspective
- Energy Storage modes (potential, kinetic, dissipated) and representational tools
- Energy Transfer mechanisms (via working heating, radiating)
- Conservation of energy
- Conservative vs non-conservative forces
- More on mathematical modeling in paradigm problems

LAB NOTES & INSTRUCTIONAL COMMENTS: Stretched Spring Lab
DEPLOYMENT EXERCISES
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