

# **MODELING INSTRUCTION in HIGH SCHOOL PHYSICS**

## **Teacher s Guide**

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**2002**

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Presentation criteria  
Lab report formats  
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##### **INSTRUCTIONAL GOALS**

Experimental design, control of variables, measurement, underlying assumptions  
Data collection  
Mathematical modeling (data analysis, interpreting graphs)  
Evaluation of the pendulum model  
Lab Report: presentation and defense of findings

##### **LAB NOTES & INSTRUCTIONAL COMMENTS:**

Pendulum Lab, Types of Graphs Suite of Labs

##### **STUDENT MATERIALS:**

Graphical methods  
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##### **DEPLOYMENT EXERCISES**

##### **TESTS & QUIZZES**

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Reference system, position and trajectory  
What is a particle model?  
Vectorial vs scalar concepts  
What is a free particle (FP)? What is its domain?  
FP s kinematical properties and law of motion  
Motion map  
Multiple representations (graphical, algebraic, diagrammatic)  
Dimensions and units

LAB NOTES & INSTRUCTIONAL COMMENTS : Battery-Powered Vehicle Lab  
STUDENT MATERIALS - Motion Maps  
DEPLOYMENT EXERCISES  
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Acceleration vs. velocity  
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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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Superposition principle  
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Statics: equilibrium of a particle

LAB NOTES & INSTRUCTIONAL COMMENTS:

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Spreadsheets and vector analysis

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Friction  
Modeling in paradigm problems

LAB NOTES & INSTRUCTIONAL COMMENTS:

Modified Atwood's Machine Lab, Friction Lab

STUDENT MATERIALS - Types of friction

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**Describing and Explaining Translation in a Plane by Combining FP and One-Dimensional CFP models**

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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  
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LAB NOTES & INSTRUCTIONAL COMMENTS: Behavior of a Projectile

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**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

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LAB NOTES & INSTRUCTIONAL COMMENTS: Circular Motion

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### **Conservation of Linear Momentum**

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Linear momentum and impulse  
Newton's 1st and 2nd laws revisited  
Elastic vs inelastic collisions: conservation of linear momentum vs conservation of energy

LAB NOTES & INSTRUCTIONAL COMMENTS: Momentum Lab

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## **APPENDIX A**

SUGGESTED READINGS

## **APPENDIX B**

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MECHANICS BASELINE TEST  
TEST of UNDERSTANDING GRAPHING-KINEMATICS