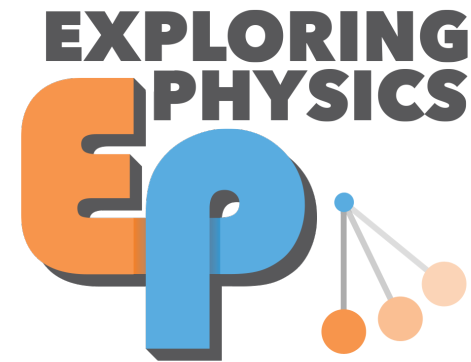


Exploring Physics Curriculum App

Missouri State Standards, NGSS and Math Common Core

Alignment by Activity for eUnits 1-8



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Exploring Physics Unit 1: Introduction to Electricity

Alignment by Activity with Next Generation Science Standards* Disciplinary Core Ideas and Mathematics Common Core Standards§

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Activity	NGSS Disciplinary Core Ideas (High School)	Science Practices	Math Common Core Standards	Math Practices	MO 2016
Getting Charged Lab	PS2.B.c, PS3.B.c				
Reading Page: What is Static Electricity?	PS1.A.a, PS2.B.c	SP8			
Getting Charged Lab - Revisited	PS2.B.c, PS3.B.c				
Practice 1.1: Electrical Charges	PS2.B.c	SP2			
A Bulb, A Battery and A Wire		SP2			
Reading Page: Contact Points and Light Bulbs					
Practice 1.2: The Bulb Challenge		SP2			
Reading Page: Circuit Elements					
Electrical Materials Lab	S3.A.d	SP3, SP4, SP6			
The Buzzer and the Motor Lab		SP2, SP6			

Practice 1.3.: Flow Challenge		SP6			
Reading Page: What is Charge?	PS1.A.a, PS3.A.d	SP8			9-12-PS3- A-2
What is Current?					
Practice 1,4: Current through Devices	PS3.A.d	SP6			9-12-PS3- A-2
Bulbs and Switches Lab		SP2, SP6			
Reading Page: The Switch*					
Practice 1.5: Circuits with a Switch		SP6			
Electrical Elements Application Lab		SP2, SP4			
The Everyday-Stuff Battery Lab	PS3.A.d	SP1, SP2, SP3, SP4, SP6			9-12 PS3- A-3
Reading Page: How do Batteries Work?	PS3.A.d, PS3.B.c	SP8	HSN.Q.A.2		9-12 PS3-A-3
Practice 1.6: Battery Challenge	PS3.A.d	SP6			9-12 PS3-A-3

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<http://www.corestandards.org/Math/>

NOTE: The MO 2016 Standards are broad standards that can lead to interpretation. Since the addendums from the MO DESE indicates that NGSS was used to guide the work, the reviewer has assumed the descriptions for the Disciplinary Core Ideas are similar to NGSS

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Exploring Physics Unit 2: Electrical Circuits

Alignment by Activity with Next Generation Science Standards* Disciplinary Core Ideas and Mathematics Common Core Standards§

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Activity	NGSS Disciplinary Core Ideas (High School)	Science Practices	Math Common Core Standards	Math Practices	MO 2016
Current in Series Circuits Lab	PS3.A.d	SP2, SP3, SP4, SP6			9-12-PS3-A-2
Reading Page: Current in Series Circuits		SP8			
Practice 2.1: Comparing Currents in Circuits	PS3.A.d	SP6			9-12-PS3-A-2
Resistance in Series Circuits Lab	PS3.B.c	SP2, SP5		MP2	9-12-PS3-A-1
Reading Page: Resistors and Resistance		SP8			
Practice 2.2: Circuit Challenge - Series Circuit Design				MP1, MP2	
What Causes Resistance? Lab		SP1, SP2, SP6	HSS.ID.B.6	MP1, MP2, MP4	
Reading Page: Resistance		SP8	HSA.CED.A.1		
Practice 2.3: Calculating Resistance			HSA.CED.A.1, HSA.CED.A.4 HSA.REI.B.3	MP1, MP6	

Voltage in a Series Circuit Lab	PS3.B.c	SP2, SP6		MP1, MP2, MP4, MP6	9-12-PS3-A-1
Reading Page: What is Voltage?	PS3.B.b	SP8			9-12-PS3-A-1
Connecting Voltage, Current, & Resistance Lab	PS3.B.c	SP1, SP2, SP3, SP4, SP5, SP6	HSS.ID.B.6	MP1, MP2, MP4, MP6	9-12-PS3-A-1
Reading Page: Ohm's Law	PS3.B.c	SP8			9-12-PS3-A-1
Practice 2.4: Ohm's Law Problems	PS3.B.c		HSA.CED.A.1, HSA.CED.A.4, HSA.REI.B.3, HSF.IF.B.6, HSS.ID.B.6, HSS.ID.B.6.c, HSS.ID.C.7	MP1, MP2, MP6	9-12-PS3-A-1
Reading Page: Ohm's Law and Series Circuits		SP8	HSA.CED.A.4		
Practice 2.5: Series Circuits and Graph Problems	PS3.B.c	SP6	HSA.CED.A.1, HSA.CED.A.4, HSA.REI.B.3		9-12-PS3-A-1
Practice 2.6: Ohm's Law for Series Circuit	PS3.B.c	SP6	HSA.CED.A.1, HSA.CED.A.4, HSA.REI.B.3	MP1, MP2, MP6	9-12-PS3-A-1
Parallel Circuit Lab	PS3.A.d	SP2, SP5, SP6			9-12-PS3-A-2
Practice 2.7: Designing Series and Parallel Circuits					9-12-PS3-A-2
Current in a Parallel Circuit Lab	PS3.A.d	SP2, SP6		MP1, MP2, MP4	9-12-PS3-A-1
Reading Page: Parallel Circuits	PS3.A.d, PS3.B.c	SP8			9-12-PS3-A-1
Practice 2.8: Series and Parallel Circuits					9-12-PS3-A-2
Practice 2.9: Ohm's Law and Parallel Circuits	PS3.B.c	SP6	HSA.CED.A.1, HSA.CED.A.4, HSA.REI.B.3	MP1, MP2, MP6	9-12-PS3-A-1
Batteries in Series and Parallel Lab	PS3A.d, PS3B.c	SP2, SP4, SP6			9-12-PS3-A-1

Reading Page: Batteries in Series & Parallel	PS3A.d	SP8			
Practice 2.10: Arranging Batteries	PS3B.c	SP6			9-12-PS3-A-1
Resistance of a Parallel Circuit Lab	PS3.B.c	SP2	HSA.CED.A.1, HSA.CED.A.4	MP1, MP2	9-12-PS3-A-2
Reading Page: The Resistance of a Parallel Circuit	PS3.B.c	SP8			9-12-PS3-A-1
Practice 2.11: Resistance in Parallel Circuits	PS3.B.c	SP6			9-12-PS3-A-1
Name That Circuit – Application Lab		SP2, SP6			
Electrical Power Lab	PS3.B.c	SP2, SP3, SP6	HSA.CED.A.1,HSA.REI.B.3	MP4	9-12-PS3-A-1
Reading Page: Power and Energy	PS3.B.c	SP8	HSA.CED.A.4		9-12-PS3-A-1
Practice 2.12: Power and Energy Problems	PS3.B.c		HSA.CED.A.1,HSA.REI.B.3	MP6	9-12-PS3-A-1
Reading Page: Direct and Alternating Current					
Electrical Widgets Application Lab					

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Exploring Physics Unit 3: Uniform Motion

Alignment by Activity with Next Generation Science Standards* Disciplinary Core Ideas and Mathematics Common Core Standards§

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Activity	NGSS Disciplinary Core Ideas (High School)	Science Practices	Math Common Core Standards	Math Practices	MO 2016
Bag of Cars Lab		SP2, SP3, SP4, SP6			
Bubble Lab		SP1, SP2, SP3, SP4, SP5, SP6	HSF.IF.B.6, HSS.ID.B.6, HSS.ID.C.7,	MP2, MP4	
Reading Page: Distance and Change in Position		SP2, SP4, SP5, SP8	HSA.CED.A.1		
Practice 3.1: Position, Distance, and Change in Position		SP2, SP4, SP5, SP6	HSA.CED.A.1	MP2	
Practice 3.2: Analyzing Position, Distance and Slope		SP2, SP4, SP5, SP6	HSA.CED.A.1, HSF.IF.B.6, HSS.ID.B.6, HSS.ID.C.7	MP2, MP6	
Reading Page: Unit Conversion		SP2, SP4, SP5, SP8	HSN.Q.A.1	MP6	

Practice 3.3: Finding Slope		SP2, SP4, SP5, SP6, SP8	HSA.CED.A.1, HSF.IF.B.6, HSS.ID.C.7	MP2
Practice 3.4: Motion with Constant Speed		SP2, SP4, SP5, SP6	HSA.CED.A.1, HSS.ID.B.6	MP2
Battery Car Lab		SP1, SP2, SP3, SP4, SP5, SP6	HSN.Q.A.1, HSA.CED.A.1, HSF.IF.B.6, HSS.ID.B.6, HSS.ID.C.7	MP1, MP2, MP4, MP6
Reading Page: Motion Diagrams		SP2, SP4, SP5, SP8		
Practice 3.5: Motion Diagrams		SP2, SP4, SP5, SP6		
Student Summary Page - Slow and Fast				
Reading Page: The Speed-Distance-Time Relation		SP2, SP4, SP5, SP6, SP8	HSN.Q.A.1, HSN.VM.A.3	MP6
Practice 3.6: Word Problems – Speed		SP2, SP4, SP5, SP6	HSN.Q.A.1, HSN.VM.A.3, HSA.CED.A.1, HSA.CED.A.4,	MP2, MP4
			HSA.REI.B.3	
Detecting Motion Lab		SP2, SP3, SP4, SP5, SP6	HSS.ID.B.6	MP2, MP4, MP6
Practice 3.7: Simulating Motion		SP2, SP4, SP5, SP6		
Reading Page: Average Speed		SP2, SP4, SP5, SP8	HSA.CED.A.1	MP2
Practice 3.8: Average Speed		SP2, SP4, SP5, SP6	HSN.VM.A.3, HSA.CED.A.1,	MP1, MP2
			HSA.REI.B.3	
Practice 3.9: Words and Graphs		SP2, SP4, SP5, SP6	HSN.VM.A.3	MP2

None align directly with the HS MO standards; more closely aligned with the middle level

Motion of Two Bikers – Conceptual Lab		SP2, SP3, SP4, SP5, SP6		MP2
Reading Page: Calculating Displacement		SP2, SP4, SP5, SP8	HSA.CED.A.1	MP2
Practice 3.10: Words, Graphs and Motion Diagrams		SP2, SP4, SP5, SP6	HSA.CED.A.1, HSS.ID.B.6	MP2
Practice 3.11: Equivalent Representations		SP2, SP4, SP5, SP6	HSA.CED.A.1	MP2
Student Summary Page: Comparing Positive and Negative				
Toy Car Application Lab		SP2, SP3, SP4, SP5, SP6		MP4

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Exploring Physics Unit 4: Accelerated Motion

Alignment by Activity with Next Generation Science Standards* Disciplinary Core Ideas and Mathematics Common Core Standards§

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Activity	NGSS Disciplinary Core Ideas (High School)	Science Practices	Math Common Core Standards	Math Practices	MO 2016
Bag of Cars – Again	PS2.A.a	SP2, SP3, SP4, SP5, SP6			9-12-PS2-A-1
Down the Ramp Lab: Part I	PS2.A.a	SP1, SP2, SP3, SP4, SP5, SP6	HSA.CED.A.1, HSS.ID.B.6, HSS.ID.C.7	MP1, MP4	9-12-PS2-A-1
Reading Page: Motion Diagrams I	PS2.A.a	SP2, SP4, SP5, SP8		MP2	9-12-PS2-A-1
Practice 4.1: Motion Diagrams with Changing Speed	PS2.A.a	SP2, SP4, SP5, SP6, SP8		MP2	9-12-PS2-A-1
Reading Page: Instantaneous Velocity: Geometric Method	PS2.A.a	SP2, SP4, SP5, SP8	HSS.ID.C.7		9-12-PS2-A-1
Practice 4.2: Velocity of a Toy Car	PS2.A.a	SP2, SP4, SP5, SP6, SP8	HSF.IF.B.6, HSS.ID.C.7		9-12-PS2-A-1
Reading Page: Calculating a v-t graph for motion with changing speed	PS2.A.a	SP2, SP4, SP5, SP8	HSN.VM.A.2, HSS.ID.C.7		9-12-PS2-A-1
Down the Ramp Lab: Part 2	PS2.A.a	SP2, SP3, SP4, SP5	HSA.CED.A.1, HSF.IF.B.6, HSS.ID.B.6, HSS.ID.C.7	MP2, MP4	9-12-PS2-A-1

Practice 4.3: Analyze Uniform Acceleration Data I	PS2.A.a	SP2, SP4, SP5, SP6, SP8	HSN.VM.A.2, HSN.VM.A.3, HSS.ID.B.6, HSS.ID.C.7		9-12-PS2-A-1
Reading Page: Acceleration	PS2.A.a	SP2, SP4, SP5, SP8	HSA.CED.A.2		9-12-PS2-A-1
Practice 4.4: Velocity and Acceleration	PS2.A.a	SP2, SP4, SP5, SP6, SP8	HSN.VM.A.3, HSF.IF.B.6, HSS.ID.C.7		9-12-PS2-A-1
Reading Page: Motion Diagrams II	PS2.A.a	SP2, SP4, SP5, SP8		MP2	9-12-PS2-A-1
Practice 4.5: Motion Diagrams with Constant Acceleration	PS2.A.a	SP2, SP4, SP5, SP6, SP8		MP2	9-12-PS2-A-1
Reading Page: Positive and Negative Velocities	PS2.A.a	SP2, SP4, SP5, SP8	HSS.ID.C.7		9-12-PS2-A-1
Reading Page: Correlating Graphs to Motion Diagrams	PS2.A.a	SP2, SP4, SP5, SP8		MP2	9-12-PS2-A-1
Practice 4.6: Graphs and Motion Diagrams	PS2.A.a	SP2, SP4, SP5, SP6, SP8	HSF.IF.B.6, HSS.ID.C.7	MP2	9-12-PS2-A-1
Student Summary Page - Accelerated Motion					
Practice 4.7: Motion Diagrams, x-t and v-t Graphs	PS2.A.a	SP2, SP4, SP5, SP6, SP8	HSN.VM.A.3	MP2	9-12-PS2-A-1
Motion Along an Incline - Photogate Lab	PS2.A.a	SP1, SP2, SP3, SP4, SP5, SP6	HSF.IF.B.6, HSS.ID.B.6, HSS.ID.C.7	MP4	9-12-PS2-A-1
Reading Page: How far do accelerating objects travel?	PS2.A.a	SP2, SP4, SP5, SP6, SP8	HSA.CED.A.2, HSA.REI.B.3		9-12-PS2-A-1
Practice 4.8: Distance traveled - Graphical Calculations	PS2.A.a	SP2, SP4, SP5, SP6, SP8	HSA.REI.B.3	MP6	9-12-PS2-A-1
Speeding Up and Slowing Down Lab	PS2.A.a	SP2, SP3, SP4, SP5	HSF.IF.B.4, HSF.IF.B.6, HSS.ID.C.7		9-12-PS2-A-1
Practice 4.9: Up and Down the Ramp	PS2.A.a	SP2, SP4, SP5, SP6, SP8		MP1, MP2	9-12-PS2-A-1

Practice 4.10: Simulating Accelerated Motion	PS2.A.a	SP2, SP4, SP5, SP6, SP8			9-12-PS2-A-1
Reading Page: Using Motion Equations	PS2.A.a	SP1, SP2, SP4, SP5, SP8	HSA.CED.A.1, HSA.CED.A.2		9-12-PS2-A-1
Practice 4.11: Word Problems - Accelerated Motion	PS2.A.a	SP2, SP4, SP5, SP6, SP8	HSS.VM.A.2, HSN.VM.A.3, HSA.REI.B.3, HSF.IF.B.4	MP1, MP2, MP6	9-12-PS2-A-1
Reading Page: Using Motion Equations to Generate Graphs	PS2.A.a	SP2, SP4, SP5, SP6, SP8	HSA.CED.A.1, HSA.CED.A.2, HSF.IF.B.4, HSS.ID.B6	MP1, MP2, MP6	9-12-PS2-A-1
Practice 4.12: Motion with Acceleration - Data Tables and Graphs	PS2.A.a	SP2, SP4, SP5, SP6, SP8	HSS.VM.A.2, HSN.VM.A.3, HSA.REI.B.3, HSF.IF.B.4, HSS.ID.B6	MP1, MP2, MP6	9-12-PS2-A-1
Practice 4.13: Motion with Acceleration - Words & Graphs	PS2.A.a	SP2, SP4, SP5, SP6, SP8	HSS.VM.A.2, HSN.VM.A.3, HSA.REI.B.3, HSF.IF.B.4, HSS.ID.B6, HSS.ID.C7,	MP1, MP2, MP6	9-12-PS2-A-1
Practice 4.14: Motion with Acceleration - Stacks of Graphs	PS2.A.a	SP2, SP4, SP5, SP6, SP8	HSF.IF.B.4, HSF.IF.B.6, HSF.IF.C7		9-12-PS2-A-1
Two Accelerating Objects - Conceptual Lab	PS2.A.a	SP2, SP3, SP4, SP5	HSF.IF.B.4, HSF.IF.C.9, HSS.ID. C7, HSF.LE.A.1.b		9-12-PS2-A-1
Student Summary Page - Uniform Motion Accelerated Motion					
Testing Cars - Application Lab	PS2.A.a	SP2, SP3, SP4, SP5			9-12-PS2-A-1
Framing Questions Revisited					
Accelerated Motion Review					

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Exploring Physics Unit 5: Forces and Newton's Laws. Alignment by Activity with Next Generation Science Standards* Disciplinary Core Ideas and Mathematics Common Core Standards§

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Activity	NGSS Disciplinary Core Ideas (High School)	Science Practices	Math Common Core Standards	Math Practices	MO 2016
Exerting Forces Lab		SP2, SP3, SP4			
Reading page: What is a force?	PS2.B.b, PS2.B.c	SP2, SP8			9-12 PS2- B-4
Broom Ball – The Game Lab		SP2, SP3, SP4			
Reading page: Drawing and Analyzing Forces		SP2, SP4, SP5			
Practice 5.1: Force Challenge		SP2, SP4, SP5			
The Normal Force Lab		SP2, SP3, SP4, SP5			
The Force of Gravity Lab	PS2.B.a, PS2.B.b	SP1, SP2, SP3, SP4, SP5, SP6	HSA.CED.A.2, HSF.IF.B.6, HSS.ID.B.6, HSS.ID.C.7	MP4	9-12 PS2- B-4
Reading Page: Measuring the Force of Gravity (Weight)	PS2.B.a, PS2.B.b	SP2, SP6, SP8	HSN.Q.A.1		9-12 PS2- B-4
Practice 5.2: Force of Gravity and its Strength	PS2.B.a, PS2.B.b	SP4, SP5	HSN.Q.A.1		9-12 PS2- B-4

The Elastic Force Lab		SP1, SP2, SP3, SP4, SP5, SP6	HSA.CED.A.2, HSF.IF.B.6, HSS.ID.B.6, HSS.ID.C.7	MP4	
Practice 5.3: Forces in springs		SP4, SP5	HSS.ID.B.6		
Reading page: Drawing Force Diagrams		SP2, SP8			
Practice 5.4: Force Diagrams		SP2, SP4, SP5		MP2	
Newton's First Law Lab		SP2, SP3, SP4, SP6			
Reading Page: Newton's First Law		SP2, SP8			
Practice 5.5: Newton's First Law		SP4, SP6			
Broom Ball Lab Revisited		SP2, SP3, SP4			
Newton's Third Law Lab		SP2, SP3, SP4, SP5			
Newton's Third Law Lab with Force Probes		SP2, SP3, SP4, SP5, SP6			
Reading Page: Newton's Third Law		SP2, SP8			
Practice 5.6: Identifying Pairs of Forces		SP2, SP4, SP5, SP6		MP2	
Newton's Second Law Lab		SP2, SP3, SP4, SP5, SP6			
Reading Page: Newton's Second Law	PS2.A.a	SP2, SP8	HSA.CED.A.2		9-12 PS2-A-1
Practice 5.7: Newton's Second Law Problems	PS2.A.a	SP2, SP4, SP5, SP6	HSA.CED.A.1, HSA.CED.A.4		9-12 PS2 - A-1
Practice 5.8: Forces, Motion and Newton's Laws		SP2, SP4, SP5		MP2	

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<http://www.corestandards.org/Math/>

www.exploringphysics.com

Exploring Physics Unit 6: Applications of Newton's Laws: Free Fall and Projectile Motion
Alignment by Activity with Next Generation Science Standards* Disciplinary Core Ideas and Mathematics Common Core Standards§

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Activity	NGSS Disciplinary Core Ideas (High School)	Science Practices	Math Common Core Standards	Math Practices	MO 2016
Free Fall Lab	PS2.A.a	SP1, SP2, SP3, SP4, SP5, SP6	HSA.CED.A.1, HSA.CED.A.4, HSF.IF.B.6, HSS.ID.B.6, HSS.ID.C.7	MP1, MP2	9-12-PS2-A-1
Reading Page: Free Fall	PS2.A.a	SP2, SP4, SP5, SP6,	HSA.CED.A.2		9-12-PS2-A-1
Practice 6.1: Motion of Falling Objects	PS2.A.a	SP5, SP6	HSA.CED.A.1, HSA.REI.B.3, HSS.ID.B.6		9-12-PS2-A-1
Practice 6.2: Falling Objects - Word Problems	PS2.A.a	SP4, SP5, SP6	HSN.VM.A.3, HSS.ID.B.6		9-12-PS2-A-1
Throw the Ball Upwards Lab	PS2.A.a	SP1, SP2, SP3, SP4, SP5, SP6	HSN.VM.A.3, HSA.CED.A.1, HSA.REI.B.3, HSF.IF.B.6, HSS.ID.A.3, HSS.ID.B.6, HSS.ID.C.7	MP1, MP2, MP4	9-12-PS2-A-1

Reading Page: Up and Down Under Gravity	PS2.A.a	SP2, SP4, SP5, SP6, SP8	HSN.Q.A.1		9-12-PS2-A-1
Practice 6.3: What Goes Up, Must Come Down	PS2.A.a	SP5, SP6	HSA.CED.A.1, HSA.REI.B.3, HSS.ID.B.6		9-12-PS2-A-1
Practice 6.4: What Goes Up, Must Come Down Word Problems	PS2.A.a	SP4, SP5, SP6	HSN.VM.A.3, HSA.CED.A.1, HSA.REI.B.3, HSF.IF.B.6, HSS.ID.A.3, HSS.ID.B.6, HSS.ID.C.7	MP1, MP2, MP6	9-12-PS2-A-1
Practice 6.5: Simulating Motion Under Gravity	PS2.A.a	SP4, SP5, SP6	HSN.VM.A.3, HSS.ID.B.6		9-12-PS2-A-1
Reading Page – Newtons Law of Universal Gravity	PS2.B.a	SP2, SP5	HSA.CED.A.1, HSA.REI.B.3, HSS.ID.B.6		9-12-PS2-A-1
Practice 6.6: Gravity on other planets	PS2.B.a	SP4, SP5, SP6	HSN.VM.A.3, HSA.CED.A.1, HSA.REI.B.3, HSF.IF.B.6, HSS.ID.A.3, HSS.ID.B.6, HSS.ID.C.7	MP1, MP2, MP6	9-12-PS2-A-1
Student Summary Page: Up and Down					9-12-PS2-A-1
Motion in Two Dimensions Lab	PS2.A.a	SP2, SP3, SP4, SP5, SP6		MP2	9-12-PS2-A-1
Horizontally Launched Projectile Lab	PS2.A.a	SP2, SP3, SP4, SP5, SP6	HSN.VM.A.3, HSA.CED.A.1, HSS.ID.B.6, HSS.ID.B.6.c	MP4	9-12-PS2-A-1
Reading Page: Motion in Two Dimensions - I	PS2.A.a	SP2, SP4, SP5, SP6, SP8	HSN.Q.A.1, HSN.VM.A.3, HSA.CED.A.2	MP2	9-12-PS2-A-1
Practice 6.7 Motion in 2 Dimensions	PS2.A.a	SP4, SP5, SP6	HSA.CED.A.1, HSA.REI.B.3, HSS.ID.B.6	MP2	9-12-PS2-A-1
Practice 6.8: Motion in 2 Dimensions Word Problems	PS2.A.a	SP4, SP5, SP6	HSN.VM.A.3, HSA.CED.A.1, HSA.REI.B.3	MP1, MP2	9-12-PS2-A-1
Practice 6.9: Simulating Projectile Motion I	PS2.A.a	SP4, SP5, SP6	HSA.CED.A.1, HSA.REI.B.3, HSS.ID.B.6	MP2	9-12-PS2-A-1

Student Summary Page: Free Fall and Projectile Motion					
Forces and Projectile Motion Conceptual Lab	PS2.A.a	SP4, SP5, SP6		MP2	9-12-PS2-A-1
Hit theTarget Lab- Practicum	PS2.A.a	SP2, SP3, SP4, SP5, SP6	HSN.VM.A.3, HSA.CED.A.1	MP4	9-12-PS2-A-1
Student Summary Page: Comparing Free Fall to Projectile Motion					
Launching Darts Lab	PS2.A.a	SP1, SP2, SP3, SP4, SP5, SP6	HSS.ID.B.6		9-12-PS2-A-1
Reading Page: Motion in Two Dimensions, II	PS2.A.a	SP2, SP4, SP5, SP6, SP8			9-12-PS2-A-1
Practice 6.10: Trajectory Challenge	PS2.A.a	SP4, SP5, SP6			9-12-PS2-A-1
Practice 6.11: Simulating Projectile Motion II	PS2.A.a	SP4, SP5, SP6	HSA.CED.A.1, HSA.REI.B.3		9-12-PS2-A-1

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www.exploringphysics.com

Exploring Physics Unit 7: Linear Momentum

Core Standards§

Exploring Physics, The Curriculum App is an interactive inquiry- and modeling-based conceptual physics curriculum. It combines hands-on activities with a discussion-based pedagogy where students construct mental models of scientific concepts. The content covers a full year's conceptual physics curriculum for 9th grade through early college.

NGSS alignment was conducted by the Biological Science Curriculum Study, BSCS, Colorado Springs, Co, <http://www.bscs.org>. Missouri 2016 Science Standards alignment was conducted by Sara S. Torres, Executive Director of the Arizona Science Teachers Association, Flandrau Science Center and Planetarium, Tucson, Az and former Curriculum Director at Columbia Public Schools, Columbia Mo.

Activity	NGSS Disciplinary Core Ideas (High School)	Science Practices	Math Common Core Standards	Math Practices	MO 2016
Exploring Collisions Lab	PS2.A.b	SP2, SP3, SP4, SP5, SP6		MP1, MP2	9-12-PS2-A-2
Reading Page: Impulse	PS2.A.b	SP4, SP5, SP6	HSA.CED.A.2	MP1, MP2	9-12-PS2-A-2
Practice 7.1: Impulse	PS2.A.b	SP4, SP5, SP6	HSN.VM.A.3, HSA.CED.A.1, HSA.REI.B.3		9-12-PS2-A-2
Reading Page: Linear Momentum	PS2.A.b	SP2, SP4, SP5, SP6, SP8	HSN.Q.A.1, HSA.CED.A.2		9-12-PS2-A-2
Practice 7.2: Calculating Linear Momentum	PS2.A.b	SP4, SP5, SP6	HSA.CED.A.1		9-12-PS2-A-2
Connecting Impulse and Momentum Lab	PS2.A.b	SP2, SP4, SP5, SP6, SP8	HSA.CED.A.2		9-12-PS2-A-2
Reading Page: Connecting Impulse and Change in Momentum	PS2.A.b	SP2, SP4, SP5, SP6, SP8	HSA.CED.A.2		9-12-PS2-A-2

Practice 7.3: Impulse and Change in Momentum	PS2.A.b	SP4, SP5, SP6	HSA.CED.A.1, HSA.REI.B.3	MP1, MP2, MP6	9-12-PS2-A-2
Elastic and Inelastic Collisions Lab	PS2.A.b	SP2, SP3, SP4, SP5, SP6			9-12-PS2-A-2
Reading Page: Types of Collisions	PS2.A.b	SP4, SP5, SP6	HSA.CED.A.2		9-12-PS2-A-2
Momentum in Collisions Lab	PS2.A.b	SP2, SP3, SP4, SP5, SP6	HSA.CED.A.1		9-12-PS2-A-2
Reading Page: Conservation of Linear Momentum	PS2.A.b	SP2, SP4, SP5, SP6, SP8	HSA.CED.A.2		9-12-PS2-A-2
Practice 7.4: Applying Conservation of Momentum	PS2.A.b	SP4, SP5, SP6	HSN.VM.A.3, HSA.CED.A.1, HSA.REI.B.3	MP1, MP2, MP6	9-12-PS2-A-2

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www.exploringphysics.com

Exploring Physics Unit 8: Energy

Alignment by Activity with Next Generation Science Standards* Disciplinary Core Ideas and Mathematics Common Core Standards§

Exploring Physics, The Curriculum App is an interactive inquiry- and modeling-based conceptual physics curriculum. It combines hands-on activities with a discussion-based pedagogy where students construct mental models of scientific concepts. The content covers a full year's conceptual physics curriculum for 9th grade through early college.

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Activity	NGSS Disciplinary Core Ideas (High School)	Science Practices	Math Common Core Standards	Math Practices	MO 2016
Exploring Energy – Lab	PS1.B.a, PS2.A.a, PS2.A.b, PS2.B.a, PS2.B.b, PS3.A.b, PS3.A.c, PS3.B.b, PS3.B.e, PS3.C.a, PS3.D.a	SP2, SP3			9-12-PS1-B-6, 9-12-PS2-A-1, 9-12-PS2-A-2, 9-12-PS2-A-4, 9-12-PS3-A-1, 9-12-PS3-A-2, 9-12-PS3-B-4. 9-12-PS3-C-5
Reading Page: Energy	PS3.A.a, PS3.B.a, PS3.B.b				9-12-PS3-A-1
Practice 8.1. Physical systems, states, processes	PS1.B.a, PS2.A.a, PS2.A.b, PS2.B.a, PS2.B.b, PS3.A.b, PS3.A.c, PS3.B.b, PS3.B.e, PS3.C.a, PS3.D.a	SP2, SP3			9-12-PS2-A-1, 9-12-PS2-A-4, 9-12-PS3-A-1, 9-12-PS3-A-2, 9-12-PS3-B-4. 9-12-PS3-C-5
Reading Page: The Law of Conservation of Energy	PS3.A.a, PS3.B.a, PS3.B.b				9-12-PS3-A-1
Exploring Energy Transformations Lab	PS2.A.c	SP2, SP3, SP6			9-12-PS3-A-2
Reading Page: Using Pie Charts to Represent Energy Storage and Transformations	PS3.A.a, PS3.B.a, PS3.D.a	SP2, SP5, SP6	HSA.SSE.B.3	MP2	9-12-PS3-A-1, 9-12-PS3-A-2, 9-12-PS3-B-4.
Practice 8.2. Energy Pie Charts	PS3.A.a, PS3.B.a, PS3.D.a	SP2, SP5, SP6	HSA.SSE.B.3	MP2	9-12-PS3-A-1, 9-12-PS3-A-2, 9-12-PS3-B-4.

Exploring Energy Transfers Lab	PS2.A.c	SP2, SP3, SP6			9-12-PS2-A-2, 9-12-PS3-A-1
Reading Page: Using Energy Bar Graphs to Represent Energy Transfers	PS3.A.a, PS3.B.a, PS3.D.a	SP2, SP5, SP6	HSA.SSE.B.3	MP2	9-12-PS3-A-1
Practice 8.3. Energy Bar Graphs	PS3.A.a, PS3.B.a, PS3.D.a	SP2, SP5, SP6	HSA.SSE.B.3	MP2	9-12-PS3-A-1, 9-12-PS3-A-3
What is Work? Lab		SP1, SP2, SP3, SP4, SP5, SP6	HSN.Q.A.1, HSA.CED.A.2, HSA.REI.B.3, HSF.IF.B.6, HSS.ID.B.6, HSS.ID.C.7	MP1, MP2, MP4, MP6	
Reading Page: Work and Energy			HSN.Q.A.1		
Practice 8.4. Calculating Work		SP4, SP5	HSA.CED.A.1	MP1, MP2, MP6	
Relating Work to Change in Energy Conceptual Lab		SP5	HSA.SSE.A.1, HSA.CED.A.1, HSA.REI.B.3	MP1, MP2, MP6	
Reading Page: Gravitational Potential Energy	PS3.B.c	SP5	HSN.Q.A.1		9-12-PS3-A-1
Practice 8.5. Gravitational Potential Energy	PS3.B.c	SP2, SP5		MP2	9-12-PS3-A-1
How much energy is stored in a spring? Elastic Potential Energy Lab	PS3.B.c	SP1, SP3, SP4, SP5, SP6	HSA.CED.A.1, HSA.CED.A.2, HSA.REI.B.3, HSF.IF.B.4, HSF.IF.B.6, HSS.ID.B.6, HSS.ID.C.7	MP2, MP4	9-12-PS3-A-1
Reading Page: Elastic Potential Energy	PS3.B.c		HSA.SSE.A.1.a, HSA.CED.A.2, HSA.REI.A.1		9-12-PS3-A-1

Practice 8.6. Energy in Springs	PS3.B.c	SP2, SP4, SP5	HSA.CED.A.1, HSA.REI.A.1, HSF.IF.B.4, HSS.ID.B.6	MP1, MP2, MP6	9-12-PS3-A-1
How much energy do we have when moving? Kinetic Energy Lab	PS3.B.c	SP2, SP3, SP4, SP5, SP6	HSN.Q.A.1, HSA.SSE.A.1, HSA.SSE.A.1.a, HSA.CED.A.2, HSA.REI.A.1, HSF.IF.B.4, HSF.IF.B.6, HSS.ID.B.6, HSS.ID.B.6.c, HSS.ID.C.7	MP4	9-12-PS3-A-1
Reading Page: Kinetic Energy	PS3.B.c		HSN.Q.A.1, HSA.CED.A.2		9-12-PS3-A-1
Practice 8.7. Kinetic Energy	PS3.B.c		HSN.VM.A.3, HSA.CED.A.1, HSF.IF.B.4, HSS.ID.B.6	MP1, MP2, MP6	9-12-PS3-A-1
Practice 8.8. Conservation of Energy Problems	PS3.B.c	SP2	HSN.VM.A.3, HSA.CED.A.1	MP1, MP2, MP6	9-12-PS3-A-1
Human Power Lab		SP3, SP4, SP5, SP6	HSN.Q.A.1, HSA.SSE.A.1, HSA.CED.A.1	MP2, MP4	
Reading Page: Power			HSN.Q.A.1, HSA.SSE.A.1, HSA.CED.A.2		
Practice 8.9. Power			HSA.CED.A.1	MP2	

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Comparison of High School Physical Science NGSS and Missouri Science Standards

prepared by Meera Chandrasekhar and Dorina Kosztin, Department of Physics and Astronomy, University of Missouri, Columbia Mo, July

NGSS Performance Expectations	NGSS DCIs	Missouri Learning Standards GLEs Spring 2016
PS2 - Motion and Stability: Forces and Interactions		
	PS2.A: Forces and Motion	A. Forces and Motion
HS-PS2-1. Analyze data to support the claim that Newton's second law of motion describes the mathematical relationship among the net force on a macroscopic object, its mass, and its acceleration.	a. Newton's second law accurately predicts changes in the motion of macroscopic objects.	9-12-PS2 -1 Analyze data to support and verify the concepts expressed by Newton's 2nd law of motion, as it describes the mathematical relationship among the net force on a macroscopic object, its mass, and its acceleration. [Clarification Statement: Examples of data could include tables or graphs of position or velocity as a function of time for objects subject to a net unbalanced force, such as a falling object, an object rolling down a ramp, or a moving object being pulled by a constant force.]
HS-PS2-2. Use mathematical representations to support the claim that the total momentum of a system of objects is conserved when there is no net force on the system.		
HS-PS2-3. Apply scientific and engineering ideas to design, evaluate, and refine a device that minimizes the force on a macroscopic object during a collision.	b. Momentum is defined for a particular frame of reference; it is the mass times the velocity of the object.	9-12-PS2-2 Use mathematical representations to support and verify the concepts that the total momentum of a system of objects is conserved when there is no net force on the system. [Clarification Statement: Emphasis is on the quantitative conservation of momentum in interactions and the qualitative meaning of this principle.]
HS-PS2-4. Use mathematical representations of Newton's Law of Gravitation and Coulomb's Law to describe and predict the gravitational and electrostatic forces between objects.		

HS-PS2-5. Plan and conduct an investigation to provide evidence that an electric current can produce a magnetic field and that a changing magnetic field can produce an electric current.	c. If a system interacts with objects outside itself, the total momentum of the system can change; however, any such change is balanced by changes in the momentum of objects outside the system.	9-12-PS2-3 Apply scientific principles of motion and momentum to design, evaluate, and refine a device that minimizes the force on a macroscopic object during a collision. [Clarification Statement: Examples of evaluation and refinement could include determining the success of the device at protecting an object from damage and modifying the design to improve it. Examples of a device could include a football helmet or a parachute.]
HS-PS2-6. Communicate scientific and technical information about why the molecular-level structure is important in the functioning of designed materials.*	PS2.B. Types of Interactions	B. Types of Interactions
	a. Newton's law of universal gravitation and Coulomb's law provide the mathematical	9-12-PS2 -4 Use mathematical representations of Newton's Law of Gravitation to describe and predict
	b. Forces at a distance are explained by fields (gravitational, electric, and magnetic) permeating space that can transfer energy through space. Magnets or electric currents cause magnetic fields; electric charges or changing magnetic fields cause electric fields.	9-12-PS2-5 Plan and conduct an investigation to provide evidence that an electric current can produce a magnetic field and that a changing magnetic field can produce an electric current.
PS3. Energy		
	PS3.A Definitions of Energy	A. Definitions of Energy
HS-PS3-1. Create a computational model to calculate the change in the energy of one component in a system when the change in energy of the other component(s) and energy flows in and out of the system are known.	a. Energy is a quantitative property of a system that depends on the motion and interactions of matter and radiation within that system. That there is a single quantity called energy is due to the fact that a system's total energy is conserved, even as, within the system, energy is continually transferred from one object to another and between its various possible forms.	9-12-PS3- 1 Create a computational model to calculate the change in the energy of one component in a system when the changes in energy are known. [Clarification Statement: Emphasis is on explaining the meaning of mathematical expressions used in the model.]
HS-PS3-2. Develop and use models to illustrate that energy at the macroscopic scale can be accounted for as a combination of energy associated with the motions of particles (objects) and energy associated with the relative position of particles (objects).		

HS-PS3-3. Design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy.*	b. At the macroscopic scale, energy manifests itself in multiple ways, such as in motion, sound, light, and thermal energy.	
HS-PS3-4. Plan and conduct an investigation to provide evidence that the transfer of thermal energy when two components of different temperature are combined within a closed system results in a more uniform energy distribution among the components in the system (second law of thermodynamics).	c. These relationships are better understood at the microscopic scale, at which all of the different manifestations of energy can be modeled as a combination of energy associated with the motion of particles and energy associated with the configuration (relative position of the particles). In some cases the relative position energy can be thought of as stored in fields (which mediate interactions between particles). This last concept includes radiation, a phenomenon in which energy stored in fields moves across space.	9-12-PS3- 2 Develop and use models to illustrate that energy at the macroscopic scale can be accounted for as a combination of energy associated with the motions of particles (objects) and energy associated with the relative position of particles (objects). [Clarification Statement: Examples of phenomena at the macroscopic scale could include the conversion of kinetic energy to thermal energy, the energy stored due to position of an object above the earth, and the energy stored between two electrically-charged plates. Examples of models could include diagrams, drawings, descriptions, and computer simulations.]
HS-PS3-5. Develop and use a model of two objects interacting through electric or magnetic fields to illustrate the forces between objects and the changes in energy of the objects due to the interaction.	d. “Electrical energy” may mean energy stored in a battery or energy transmitted by electric currents.	
	PS3.B Conservation of Energy and Energy Transfer	B. Conservation of Energy and Energy Transfer
	a. Conservation of energy means that the total change of energy in any system is always equal to the total energy transferred into or out of the system.	9-12-PS3- 1 Create a computational model to calculate the change in the energy of one component in a system when the changes in energy are known. [Clarification Statement: Emphasis is on explaining the meaning of mathematical expressions used in the model.]
	b. Energy cannot be created or destroyed, but it can be transported from one place to another and transferred between systems.	

	c. Mathematical expressions, which quantify how the stored energy in a system depends on its configuration (e.g. relative positions of charged particles, compression of a spring) and how kinetic energy depends on mass and speed, allow the concept of conservation of energy to be used to predict and describe system behavior.	
	d. The availability of energy limits what can occur in any system.	
	e. Uncontrolled systems always evolve toward more stable states—that is, toward more uniform energy distribution (e.g., water flows downhill, objects hotter than surrounding environment cool down).	
	PS3.C Relationships Between Energy and Forces	C. Relationships Between Energy and Forces
	a. When two objects interacting through a field change relative position, the energy stored in the field is changed.	9-12-PS3 - 5 Develop and use a model of two objects interacting through electric or magnetic fields to illustrate the forces between objects and the changes in energy of the objects due to the interaction. . [Clarification Statement: Examples of models could include drawings, diagrams, and texts, such as drawings of what happens when two charges of opposite polarity are near each other.]
	PS3.D Energy in Chemical Processes	D. Energy in Chemical Process and Everyday Life
	a. Although energy cannot be destroyed, it can be converted to less useful forms—for example, to thermal energy in the surrounding environment.	
	b. Solar cells are human-made devices that likewise capture the sun’s energy and produce electrical energy.	

PS4. Waves and Electromagnetic Radiation		
HS-PS4-1. Use mathematical representations to support a claim regarding relationships among the frequency, wavelength, and speed of waves traveling in various media.	PS4.A Wave Properties	A. Wave Properties
HS-PS4-2. Evaluate questions about the advantages of using a digital transmission and storage of information.	a. The wavelength and frequency of a wave are related to one another by the speed of travel of the wave, which depends on the type of wave and the medium through which it is passing.	9-12-PS4-1 Use mathematical representations to support a claim regarding relationships among the frequency, wavelength, and speed of waves traveling in various media. [Clarification Statement: Examples of data could include electromagnetic radiation traveling in a vacuum and glass, sound waves traveling through air and water, and seismic waves traveling through the Earth.]
HS-PS4-3. Evaluate the claims, evidence, and reasoning behind the idea that electromagnetic radiation can be described either by a wave model or a particle model, and that for some situations one model is more useful than the other.		
HS-PS4-4. Evaluate the validity and reliability of claims in published materials of the effects that different frequencies of electromagnetic radiation have when absorbed by matter.	b. Information can be digitized (e.g., a picture stored as the values of an array of pixels); in this form, it can be stored reliably in computer memory and sent over long distances as a series of wave pulses.	
HS-PS4-5. Communicate technical information about how some technological devices use the principles of wave behavior and wave interactions with matter to transmit and capture information and energy.	c. Waves can add or cancel one another as they cross, depending on their relative phase (i.e., relative position of peaks and troughs of the waves), but they emerge unaffected by each other. (Boundary: The discussion at this grade level is qualitative only; it can be based on the fact that two different sounds can pass a location in different directions without getting mixed up.)	9-12-PS4-2 Evaluate the claims, evidence, and reasoning behind the idea that electromagnetic radiation can be described either by a wave model or a particle model, and that for some situations one model is more useful than the other. [Clarification Statement: Emphasis is on how the experimental evidence supports the claim and how a theory is generally modified in light of new evidence. Examples of a phenomenon could include resonance, interference, diffraction, and photoelectric effect.]

	PS4.B: Electromagnetic Radiation	B. Electromagnetic Radiation
	a. Electromagnetic radiation (e.g., radio, microwaves, light) can be modeled as a wave of changing electric and magnetic fields or as particles called photons. The wave model is useful for explaining many features of electromagnetic radiation, and the particle model explains other features.	9-12-PS4-3 Communicate technical information about how electromagnetic radiation interacts with matter. [Clarification Statement: Examples could include solar cells capturing light and converting it to electricity; medical imaging; and communications technology.]
	b. When light or longer wavelength electromagnetic radiation is absorbed in matter, it is generally converted into thermal energy (heat). Shorter wavelength electromagnetic radiation (ultraviolet, X-rays, gamma rays) can ionize atoms and cause damage to living cells.	9-12-PS4 -4 Evaluate the validity and reliability of claims in published materials of the effects that different frequencies of electromagnetic radiation have when absorbed by matter. [Clarification Statement: Emphasis is on the idea that photons associated with different frequencies of light have different energies, and the damage to living tissue from electromagnetic radiation depends on the energy of the radiation. Examples of published materials could include trade books, magazines, web resources, videos, and other passages that may reflect bias.]
	c. Photoelectric materials emit electrons when they absorb light of a high-enough frequency.	

	PS4.C: Information Technologies and Instrumentation	
	a. Multiple technologies based on the understanding of waves and their interactions with matter are part of everyday experiences in the modern world (e.g., medical imaging, communications, scanners) and in scientific research. They are essential tools for producing, transmitting, and capturing signals and for storing and interpreting the information contained in them.	

Additional standards in Missouri Learning Standards that are not explicitly addressed in NGSS DCIs.

9-12-PS3 -3 Design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy.

[Clarification Statement: Emphasis is on both qualitative and quantitative evaluations of devices. Examples of devices could include Rube Goldberg devices, wind turbines, solar cells, solar ovens, and generators. Examples of constraints could include use of renewable energy forms and efficiency.]

9-12-PS3 -4 Plan and conduct an investigation to provide evidence that the transfer of thermal energy when two components of different temperature are combined within a closed system results in a more uniform energy distribution among the components in the system (second law of thermodynamics). [Clarification Statement: Emphasis is on analyzing data from student investigations and using mathematical thinking to describe the energy changes both quantitatively and conceptually. Examples of investigations could include mixing liquids at different initial temperatures or adding objects at different temperatures to water.]