

# NTTI Media-Rich Lesson

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On a Collision Course  
LESSON TITLE

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9<sup>th</sup> - 12<sup>th</sup> Grades  
GRADE LEVELS

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One hour  
TIME ALLOTMENT

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## OVERVIEW

Students will use the carts/hot wheels used earlier in the experiment on “Let’s Go to the Races.”

Students will review properties of two-dimensional motion (mass, velocity, displacement and acceleration) as it relates to conservation of momentum and evaluate these properties using homemade carts powered by balloons.

Students will be given a zip lock bag with all materials needed to use with their carts to explore activities to analyze the concept of momentum. Meter sticks, paper and stopwatches should be provided separately.

Clips from the video (advance to Momentum – property of moving objects) will introduce momentum and conservation of momentum using billiard balls. Students will be divided into two groups. One group needing personal guidance will then be introduced to a computerized based lesson on ‘Conservation of Momentum.’ A quiz is provided.

The second groups composing of students who work best independently at their own rate will do a differentiated lesson provided on the web site: The Physics Classroom ([www.Physicsclassroom.com/immedia/index.html](http://www.Physicsclassroom.com/immedia/index.html)) which links to other sites on momentum concepts. They will start with the Physics Classroom’s explanation of momentum with equations, view the Multimedia Physics Studio section with Physics Help for additional real life explanations. The Physics Classroom provides an excellent lesson on conservation of momentum complete with a multimedia physics sections with animation of the various cases and graphical analysis with equations. A quiz is also included.

Students will work in groups of four to gather data needed. Basic directions will be followed by all students, after which extended activities will allow students to use innovative ways to investigate methods to study the effect of elastic and non elastic collisions in various situations. Students will then use a spreadsheet program on the computer to calculate the speed, momentum, and make graphs of data. Exit cards will be used as a closure activity.

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**SUBJECT MATTER**

**Physical Science, Physics and Algebra**

**LEARNING OBJECTIVES**

*"Students will be able to measure and analyze momentum"*

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**STANDARDS**

**Georgia Learning Connections:**

**Standard:** Investigates experimentally and solves problems relating to work, power, momentum, and impulse.

6.1 Observes and describes the conservation of momentum for elastic and inelastic collisions.

6.2 Investigates experimentally and solves problems relating to rotary work and power, angular momentum, and impulse.

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**MEDIA COMPONENTS**

Motion, Energy and Force – Episode # 101

Conservation of Momentum - Computer based lesson (PowerPoint)

<http://www.glenbrook.k12.il.us/gbssci/phys/class/momentum/momtoc.html>

The Physics Classroom – Momentum and Conservation

Lesson 1 describes the principle of impulse (momentum). Lesson 2 is the Law of Momentum Conservation. Both provide a tutorial, Multimedia Physics Studio, and Physics Help sections.

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**MATERIALS/Student**

***Momentum***

2 - Cart

2 - Small balloons

2 - Flexible straws

Masking tape – 10 cm

1 - Meter sticks

Butcher paper – 0.5 x 3 meters

1 - Markers

2 - Stopwatch (1 per group)

- 1 - Balance Scale
- 2 - Binder clamps

## PREP FOR TEACHERS

Advance the video to the frame on “Momentum right after the deceleration graph.” Pre set computers, a differentiated lesson, to the web site from Physics Classroom to the lesson on momentum and minimize. Set up the PowerPoint with the computer based lesson (CBL) on momentum. Additional speakers should be used for the sound effects. Prepare the hands-on elements of the lesson by:

Copying the following sheets, one per student:

- a. **HANDOUT 1** - Video on Momentum & Quiz Sheet
- b. **HANDOUT 2** - CBL on Conservation Sheet
- c. **HANDOUT 3** - Activity Procedure
- d. **HANDOUT 4** - Data Table and Extension Questions
- e. **HANDOUT 5** - Exit cards with one statement/question per card per student. Duplicate as needed.

## INTRODUCTORY ACTIVITY:

Focus: Introduce the lesson on conservation of momentum. Understanding the relationship between mass and velocity (momentum). Tell the students that today we will focus on momentum.

Step 1. Video: Motion, Energy and Force

**PLAY** the video at the preset position. **PAUSE** on the frame of the broken windowpane and the question, “You decide, what would happen to the path of the rock when it comes in contact with the glass.” What do you think? Provide students with a **FOCUS FOR MEDIA INTERACTION BY** asking for responses. Press **PLAY** for the correct answer “It would continue right through the glass...” **PAUSE** on the frame “Momentum: a property of moving objects.” Provide for a **FOCUS FOR MEDIA INTERACTION BY** asking students to write the definition and explaining what it means. **PLAY** to continue. **PAUSE** for students to take notes after the frame “It depends on two things the mass and the velocity with which it travels. Press **PLAY** to continue. **PAUSE** on the frame “Momentum = mass X velocity. Provide for a **FOCUS FOR MEDIA INTERACTION BY** asking students to explain this equation and comment on its meaning. **ASK** students to write the information that will be given next. **PLAY** the video and **PAUSE** after each measurement to give students time to write the information on their worksheet. **PLAY** the video until the frame appears for the calculation of momentum. Provide for a **FOCUS FOR MEDIA INTERACTION BY** asking students to work the problem and orally explain the steps. “We multiply the

mass of .3 kg. by the velocity of 100 km./hr. Let' see if we are correct. **PLAY** the video. "... = 30 kg.-km./hr.

Step 2. Conserving Momentum

**PAUSE** on the frame with the definition of the Law of the Conservation On Momentum. Provide students with a **FOCUS FOR MEDIA INTERACTION BY** asking them to write the definition and apply it to the red ball and the cue ball. **PLAY** the video. **PAUSE** on the first frame of the man playing tennis. Provide for a **FOCUS FOR MEDIA INTERACTION BY** asking students to describe the momentum of the force the player hits the ball with.

Step 3. Quiz

Pass out Handout two. Fast-forward the video to the end of question 7. **ASK** students to answer the last two questions on their handout.

**LEARNING ACTIVITIES - Differentiated**

Select students to view the computer based lesson and students to use the Physics Classroom on the computer. The Physics Classroom is independent study that is self-guided with links to concepts students need most.

**Activity (PowerPoint on Momentum)**

Step 1. Students will participate in the computer-based lesson activities on momentum and solve the problems given. **PASS** out Handout 2 to both groups.

Step 2. All students will now engage in a hands-on activity to calculate momentum. **PASS** out Handout 3 and Handout 4.

**Extension Practice:**

Give students time to experiment with their cart by using a variety of strategies to increase the momentum of their carts.

**Extension Questions:**

- "What happened when the carts start form an angle of 45 degrees to each other?"
- "What happened when the carts are facing each other before starting?"
- "What happened when one cart is still and other one hits it from behind?"

**Evaluation:**

Calculate the momentum of the three cases described above.

Advance the video to the frame “Video Quiz Follows,” for directions. After the words good luck and let’s get started, advance the video to question 9 and PLAY the video. Stop after the frame “Summing it Up.”

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## CROSS-CURRICULAR EXTENSIONS

List cross-curricular activities and interdisciplinary projects that may be generated from the lesson.

1. Physical education – momentum in baseball, football, soccer, etc.
2. Mathematics – derivation of equations, graphing properties, etc.
3. Language arts – writing across the curriculum, presentations (written and oral)

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## COMMUNITY CONNECTIONS

- Students can interview parents and neighbors about various types of races and how speed is involved. They can also collect pictures of the different types of races and make a portfolio of properties of motion.
- Contact can be made to race establishments, airports, train yards, ship-yards etc. to invite the class out to an event.
- NASA has free materials through their Education Department that can be used to enhance and facilitate activities on motion.

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## STUDENT MATERIALS

**Same zip lock bags used in “Let’s Go to the Races,” rulers, paper, stop watches,**

Cart (Select 1 per group)

Small balloons (1 per cart)

Flexible straws (1 per cart)

Masking tape

Meter sticks

Butcher paper

Markers

Stopwatch (1 per group)

Balance Scale

**NTTI Media-Rich Lesson Planning Guide**Title On a Collision CourseGrade Level(s) 9<sup>th</sup> – 12<sup>th</sup>Subject Matter Momentum**Learning Objectives** Measures and compares relationships among speed, velocity and acceleration.**Media Components – Video**1. (Motion, Energy and Force)  
Episode # 101**Time Allotment**One class periods of 60 minutes.**Overview** This lesson provides a multimedia approach to teaching a lesson on momentum. A video clip, internet sites and a PowerPoint are utilized in this lesson. A lab is also included to provide students with a hands on approach to manipulate cars in assimilation of various cases of momentum.**Standards** Students will describe the conservation of momentum for elastic and inelastic collisions.Students will investigate experimentally and solves problems relating to rotary work and power, angular momentum, and impulse.**Media Component - Web**1) <http://www.glenbrook.k12.il.us/gbssci/phys/class/momentum/momtoc.html>3) <http://www.iit.edu/~smile/physinde.html>  

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**Prep for Teachers** \_ Look at the web sites provided and select those activities most suitable for your students need. Prepare zip lock bags with as many materials as possible to expedite time in getting started in the lab. Allow students to explore on their own after the outlined lab is completed to answer other questions they may have about the activity. Students should be provided time to work at computers in groups to put in data and make the graphs necessary as well as to produce a PowerPoint presentation.



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## HANDOUT 1 - Video Momentum Sheet

Name \_\_\_\_\_ Date \_\_\_\_\_ Period \_\_\_\_\_

Momentum is \_\_\_\_\_

Equation for momentum \_\_\_\_\_

Information: Mass = \_\_\_\_\_ Velocity = \_\_\_\_\_ Equation = \_\_\_\_\_

Substituting and solving:

Conservation of Momentum \_\_\_\_\_

9. The momentum of a moving object depends on the \_\_\_\_\_  
of the object and the velocity with which it travels.

10. In this picture the white ball \_\_\_\_\_ its momentum to the red ball.



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**HANDOUT 2 - Computer Based Lesson on Conservation**

Show all steps in the calculations for the problem given in the PowerPoint Presentation.

If the mass of the large ball is 5 kg and its velocity 8 m/s and the mass of the smaller ball is 2 kg, what would the velocity of the smaller ball be if it moves away at a speed of 15 m/s and the large ball moves away with a speed of 3 m/s?

**HANDOUT 3****Activity Procedure:**

- Step 1 Students will work in groups of four. Collect required materials (2 carts, 2 small balloons, 10 cm. of tape, 1 metric ruler, 2 straws, and stopwatch).
- Step 2 A chart will be given to each student group.
- Step 3 Students will weigh their carts to determine its mass, using balance scale.
- Step 4 Set up meter sticks as tracks to measure distance carts travel.
- Step 5 Inflate the balloons by blowing through the straw and clamping it off with a binder clamp.
- Step 6 Place carts at the 0" mark and the 100 m mark of meter stick facing each other.
- Step 7 Time the carts from the beginning to the time they collide, and from the time they collide to the time they stop.
- Step 8 Record data on table provided.
- Step 9 Repeat procedures 5, 6, 7, and 8 at least 10 times.



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## HANDOUT 4

### Data Table for Momentum with homemade carts

<b>Name:</b>	<b>GROUP MEMBERS:</b>
<b>Date:</b>	
<b>Weight of cart A _____ B _____</b>	

TRIAL #	DISTANCE A (CM)	TIME A (SEC)	VELOCITY A (CM/SEC)	MOMENTUM A (M X V)	COMMENTS
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
AVE					

TRIAL #	DISTANCE B (CM)	TIME B (SEC)	VELOCITY B (CM/SEC)	MOMENTUM B (M X V)	COMMENTS
1					
2					
3					



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4					
5					
6					
7					
8					
9					
10					
AVE					

What happened when the carts start form an angle of 45 degrees to each other?

What happened when the carts are facing each other before starting?

What happened when one cart is still and other one hits it from behind?

## HANDOUT 5

### CULMINATING ACTIVITY EXIT CARDS

CARD 1

What is impulse?

CARD 2

What is impact?

CARD 3

Explain the equation for momentum?

CARD 4

Write the equation for Conservation of Momentum.

## CARD 5

Explain Conservation of Energy?

## CARD 6

Explain the Conservation of Energy in your experiment.

Call on students at random to read their answers and allow time for a brief discussion. Pass out the quiz sheet (2 questions and two problems).