<table>
<tr><td colspan="2">Unit Topic: 1D Momentum</td><td>Grade: 11 Physics</td></tr>
<tr><td colspan="3">Essential Question: What changes the momentum of an object?</td></tr>
<tr><td colspan="3">Big Idea: Momentum is conserved in a closed system</td></tr>
<tr><td colspan="2">Curricular Competencies
Use knowledge of scientific concept to draw conclusion that are consistent with evidence
Construct, analyze and interpret graphs, models and diagrams
Designing an experiment to test for the factors that changes an objects momentum and using this explain/design the safety features in a real toy car with fake passenger
predicting the factors that can change an object’s momentum or an object’s final momentum after a collision
Change in Momentum: Impulse relating newton’s 2nd law
Analyse cause- and- effect relationships</td><td>Content
Momentum
Impulse
Law of conservation of momentum
The relationship between variables
Assessment
Participation (10%), Class work (20%)
Lab experiment and reports (40%)
Unit Test (30%)</td></tr>
<tr><td colspan="3">Unit Goals:
Students will be able to define the momentum in one dimension.
Students will be able to define impulse (i.e. change in momentum)
Students will be able to state the law of conservation of momentum for isolated, one dimensional system
Students will be able to conduct an appropriate laboratory experiment.
Student will be able to with teacher support record, gather, and organise data from the experiment.
Students will be able to produce written report on the lab experiment (data analysis and interpretation).
Students will be able to apply models (e.g. Physics formulae) for problem solving on momentum, force, mass and velocity.</td></tr>
<tr><td colspan="3">Unit Rationale: Momentum is a new concept in physics for students to learn. However, momentum is built on the prior knowledge of the physics principals such as Newton’s laws of motion, vectors, Mass, Velocity. All of these concepts will help understand the concept of momentum and student will be able to appreciate life events such as impacts of object and collisions including real life crash and accidents and role of momentum in such extraordinary events.</td></tr>
<tr><td colspan="3">Vocabulary: Momentum, impulse, Collisions, explosions, closed system, isolated system, law of conservation of momentum</td></tr>
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UNIT OUTLINE

Lesson Title	Specific Objectives (Students will be able to…)	Activities (hook, body, closure)	Resources	Assessment
Lesson 1: Concept of momentum (*m*) What is the Momentum? What do you mean by the momentum in one dimension?	• Use appropriate units and metric prefixes • Define the concept of momentum in one dimension • Verify relationships between different physical variable and quantities • Practice numerical problems using equation of momentum in one dimension	Hook **(15 min)** • Teacher will show previous concept topics learned on projector screen/whiteboard. • Students will be asked to watch You tube video on car crash. • **Think-Pair-Share (TPS)**: Students will discuss in pair on the video and share with the whole class. Body (**20+35**) • Teacher will introduce the equation of momentum as a product of mass and velocity • Teacher will model and solve the several numerical problems based on the momentum equations. • Teacher will provide worksheet to practice the numerical problem solving. Closure (**10 min**) • Teacher will ask the student to write the exit slip on momentum equation and provide the homework worksheet	• PowerPoint presentation (lesson slides) • YouTube video on Car crash • Computer access • Physics 11 Textbook	• Participation • In class worksheet for problem solving for formative assessment

Lesson 2: Impulse (***F*****Δ***t)* Change in momentum	• Define Impulse • Describe impulse is the change in momentum of an object • Relate impulse as a change in momentum (***Δp*****=*****mΔv*****=*****FΔt)*** • Recognize the relation between the newton's 2nd law of motion to derive the impulse equation • Solve and practice numerical problem based on the impulse equation.	Introduction **(10 min)** • Check-in and Introduce the goals and agenda of today's class • Ask student to show and put their homework on desk for checking Body (**15+20+30 min**) • Review the concept of momentum, forces and vectors • Derive the expression for impulse from the Newton's 2nd law and describe the impulse equation and change of momentum • Model problem solving on impulse, momentum, force, mass and velocity • YouTube Video on Spiderman stopping Train activity to demonstrate the impulse • Think-Pair-Share (TPS): Students will discuss following in pair on the video and share with the whole class. Closure: (**5 min**) Teacher will summarize the impulse equation and change of momentum in one dimension.	• While board/projector • YouTube Video on Spiderman Stopping Train (https://www.youtube.com/watch?v=yRhRZB-nqOU)	• Participation • Exit Slip answering question on the Spiderman video • Homework worksheet

Lesson 3 Impulse and Change in momentum	• Describe impulse is the change in momentum of an object • Apply the concept of momentum in real life situation such as crash or collision	Introduction (**35 min**) • Student will be asked to show their homework • Think-Pair-Share: Student will be able to share their answers to their peers and discuss if they find different or similar explanations to the question. • Student will have asked to share their answers by posting they answer using Padlet. The Padlet link will be provided to the student. • Teacher debrief on the findings of the students. Body (**40 min**) • **Egg Drop Experiment**: Student will be introduced to the lab experiment to demonstrate the impulse and change in momentum • Student will be provided with handout of the experiment details • Student will be asked to read the handout and ask the question to understand the experimental details. Closure (**5 min**) • Students will have asked to confirm the group they will be working with. • Asking student to come prepared and bring the structure needed for the activity.	• Padlet link (https://padlet.com/ashokpph/ac1e2b09ojt8) • Smartphone • Projector screen for Padlet display • Handout on the experimental details	• Participation in Padlet discussion and completion of the homework.

Lesson 4 **Impulse (Lab activity)** **"Save the Egg"**	• Investigating impulse using possible laboratory experiment • Conduct an appropriate laboratory experiment. • Record, gather, and organise data from the experiment.	Introduction (10 min) • Check-in and introduce the activity and place for conducting the activity (designed for outdoor if weather permits to avoid the mess if eggs breaks otherwise in class). • Teacher will provide the rubric for assessing the investigation and each component of experiment. Body (**60 min**) • Teacher will ask each group to pick up the egg, meter scale and stop watch to do the activity. • Each group will drop the eggs from different heights and measure the time for fall and height and aim to save the Egg from breaking. • If a group is not able to save the egg, will be able to record the height, and time for their experiment and will conclude their activity. • Teacher will look after any horseplay by the student and ensure safety of the student. • As the student finish the activity they will start working analyse and writing their work to complete. Closure (**10 min**) • Teacher will discuss the date for submission of the final report of the activity performed.	• Twelve White Eggs • Meter scale • Tarp • Stop watch • Rubric for lab assessment • Safety Glasses	• Activity participation • Wooden structure made by the group to do the activity. • Collection of data by each student within the group

Lesson 5 **Conservation of Momentum**	• Describe the conservation of momentum • Apply the concept of momentum in one dimension • Problem solving	Introduction (**10 min)** • Check in and teacher will ask student to ask any question on the previous day activity or they find the activity useful to demonstrate change in momentum (feedback on the activity) **Body (10+20+30)** • **Mini Lesson**: Teacher will introduce the conservation of momentum for isolated, one dimensional system. • Model few problem solving using the law of conservation of momentum (e.g. Collisions and explosions) to determine momentum, initial and final velocity and, initial and final masses of the objects. • Demonstration using Video (Newton's cradle) • Practice numerical problems. • Quiz on the practice problems **Closure (10 min)** • Teacher will remind to bring print copy of the rough draft or almost completed of the "Save the Egg" activity. • Teacher will tell student about the introduction to a new experiment on the conservation of momentum. • Teacher remind the deadlines for the submissions of written work	Lesson Slides (https://www.slideshare.net/jan_parker/conservation-of-momentum) Video on Newton's cradle (https://www.youtube.com/watch?v=7qPvmYbfM6I) Worksheet	• Quiz for formative assessment

Lesson 6 **Laboratory Experiment on Conservation of momentum**	• Conduct an appropriate laboratory experiment. • Record, gather, and organise data from the experiment. • Revise the written report •	Introduction (**5 min**) • Check in and teacher will ask show and put their rough draft of the lab report • The teacher will assign a number to each student. Body (**20+20+30 min**) • **<u>Explosion Experiment</u>**: Student will be introduced to the lab experiment to demonstrate the impulse and change in momentum • Student will be provided with handout of the experiment details • Student will be asked to read the handout and ask the question to understand the experimental details. • **<u>Peer Assessment</u>**: The student will be asked to provide feedback/evaluate to peer's lab reports on separate paper as per the rubric provided to the students. • The even numbered student will peer evaluate odd numbered student's lab report. • Teacher will be checking peer assessment as well as will be providing feedback on incomplete lab reports. • Students are encouraged to incorporate the feedback received in their written work. Closure (**5**) • Teacher will remind to bring the printed and completed lab report tomorrow for final submission.	• Projector • Lab experiment handout	• Rough draft of the laboratory report. • Peer assessment of the reports • Completion of final lab report as homework.

Lesson 7 **Explosion Experiment**	• Investigating impulse using possible laboratory experiment • Conduct an appropriate laboratory experiment. • Record, gather, and organise data from the experiment.	Introduction (**5 min**) • Check-in and collect the final lab report for the "Save the Egg" activity. • Teacher will distribute the rubric for assessing the investigation and each component of explosion experiment. Body (**70 min**) • Teacher will ask each group of student to head to their experimental set up and familiarise themselves with experimental setup. • Ask student to set up their experiment and start collecting the data according to the procedure outlined in the experiment • Teacher will offer assistance in conducting the experiment as and when seek by the students. • Teacher will look after any horseplay by the student and ensure safety. • Teacher will ensure that everyone is engaged in taking data as the experiment will not be repeated. • Students will start working analyse and writing their work to complete the experiment. Closure (**5 min**) • Teacher will discuss the date for submission of the final report of the activity performed. • Respond to any question on the experiment	Lab on textbook page 182 The Explosion: • 2 laboratory carts (one with a spring mechanism); to imitate the actual cars • 2 C-clamps; • A blocks of wood; • 20-N spring balance; • 0.50-kg mass; • Stop watch; • Masking tape. • Physics 11 Textbook	• Active participation in the experiment. • Collection of data by each student within the group • Lab report writing for homework

Lesson 8 **Lab report on Explosion experiment**	• Perform data analysis and interpretation • Produce written report on the lab experiment • Verify the conservation of momentum equation • Synthesises the experimental finding • Analyse the cause and effect relationship	Introduction (**5 min**) • Check-in and ask student to bring up the written work on the desk for the explosion experiment. Body (**70 min**) • Teacher will ask student if they were able to collect the data of they wanted to collect the second set of data if they are not satisfied with the data obtained. • Student will have an opportunity to repeat the experiment. Those who are satisfied with dataset continue working on data analysis and compiling their work for final report. • Teacher will roam around the class and will provide written feedback while student is working on their final report. • Student will have opportunity to ask question individually on any concern relating to the experiment or content. Closure (**5 min**) • Teacher will discuss the date for submission of the final report of the activity performed. • Respond to any question on the experiment. • Remind student to bring final draft of the lab report for the peer assessment. • Remind student on review of the unit content and preparation for the unit test.	• Lab reports	• Each student will be able to receive feedback on their report (one to one feedback). • Preparation of rough draft of the lab report.

Lesson 9 **Review of the concept and Problem Solving**	• Revise the concept of momentum, Impulse (change in momentum), conservation of momentum • Practice Problem solving • Evaluate and provide on peer's work	Introduction (**5 min**) • Check-in and ask student to bring up the final draft of the lab report of the explosion experiment. Body (**60+10 min**) • Teacher will review each concept with the model to solve questions. • Teacher will provide few practice problems on each concept discussed • Teacher will include all type and forms of the practice problem (multiple type choice question, short answer type question, numerical question, True-false question, fill in the blank questions). • Teacher will conduct quiz containing all types of question expected in unit test. • Explain do's and don'ts during the unit test and availability of formula sheet • **Peer Assessment**: The student will be asked to provide feedback/evaluate to peer's lab reports on separate paper as per the rubric provided to the students. • Teacher will ask for any absences during unit test and rules for the missing the test. Closure (**5 min**) • Respond to any question or concern on the experiment or concept learned • Remind student to submit final lab report next day after unit test incorporating peer's feedback. • Remind to bring Calculators	• Handouts of the numerical problem (from Peerwise and textbook); • Projector; Calculators; Physics 11 Textbook; • Worksheet.	• Quiz worksheet • Peer's Feedback on the final draft of the lab report.

Lesson 10 **Unit Test**	• Demonstrate learning of the concepts • Apply models for problem solving on momentum, force, mass and velocity	Introduction (**5 min**) • Check-in and ask student put their bags outside the classroom. Body (**70**) • Teacher will ask student to take seat according to the test plan • Teacher will ask student keep their calculators pen, pencils with them. • Teacher will ask student to switch off/stay away from their phone in test duration and advice of no cheating. • Teacher will distribute the unit test papers and ask student begin writing the work and wish best of luck for the exams. • Teacher will collect the answer sheet for evaluation and then grading and advise them when they expect unit test to be graded. Closure (**5 min**) • Remind student to submit final lab report next day after unit test incorporating peer's feedback. • Teacher will talk about the introduction of next topic.	• Unit Test paper • Formulae sheets • Calculators	• Answer Sheets • Test Grade

Lesson 1: Introduction to Concept of Momentum

Rationale:

Students have learnt kinematics and forces in previous lessons and are now proceeding into the unit of Momentum. Specifically, this lesson is the opening of a new unit and is focusing on the introduction of momentum and the idea behind, and the basic concept of momentum in one-dimensional system. The concept of momentum is built on the physical concepts learned in the previous classes. Students will be reviewing physical concepts of force, mass, velocity and their respective units before learning the concept of momentum.

Objectives/Content Outcomes:

Students will be able to:

- Use appropriate units and metric prefixes
- Define the concept of momentum in one dimension
- Verify relationships between different physical variable and quantities
- Practice numerical problems using equation of momentum in one dimension

Teaching Schema

Time	Material/resources	Teacher activity	Student Activity
5 min.	Whiteboard; Seating Chart.	**Administrative Task:** Teacher will: ● Check the attendance; ● Make an announcement that the curriculum will not change; ● Explain class agenda.	Student will participate in attendance check.
10 min.	Whiteboard; Handouts.	**Warm up and Review:** Teacher will ● List the titles of previous learnt chapters on board; ● Give students time to discuss relationship among these chapters; ● Assess students' discussion by asking questions (e.g. What is the difference between	Possible activities for students: ● T-P-S (Think-Pair-Share): discuss in pair and then share with the whole class; ● One physics word: each student will be asked to write one physics word, for example, "velocity," on a piece of paper and submit it to the teacher.

		Kinematics and Dynamics?); ● Generate part of a concept map based on students' discussion (and later will add momentum and impulse to this map).	Then all the students that pick the same word will be put in one group and will be asked to give more details for this word and how this word related with words from other groups.
20 minutes	Whiteboard; Slides; YouTube Car crash (https://www.youtube.com/watch?v=yUpiV2I_IRI&t=188s) Physics 11 Textbook; Computer access.	**Introduction of Momentum:** Hook: ● Ask student to describe momentum and impulse based on their acquainted knowledge from daily life; ● Give examples of momentum under different circumstances: ○ In competition/sports: momentum can refer to the tendency of a person or group to repeat recent success; ○ In science: momentum is used to describe the motion of a body or a system; ○ In daily life: impulse refers to a sudden strong and unreflective urge or desire to act; the influence of a particular feeling, mental state,etc.; ○ In science: The change of momentum of a body or physical system over a time interval in classical mechanics.	Students will: ● Response to teacher's question and discuss "momentum" and "impulse" as two words from daily life; ● Give examples of events that can be described using "momentum" and "impulse" in daily life.
15 minutes	Whiteboard; Power point Slides (https://www.slideshare.net/jbishopgcms/momentum-4940831) Physics 11	**Lecture/Notes for Momentum:** Teacher will (using Handouts) ● Give notes of Basics Concepts of Momentum: ● Model examples of ○ How to calculate momentum using mass and velocity; Momentum is the product of mass and the velocity of a body; ○ Momentum is a vector quantity. The symbol	Students will ● Fill blank on handout as notes; ● Learn how to calculate momentum with examples; ● Learn how to decide the direction of the momentum; ● Learn the meaning of the units of the

	Textbook; Handouts.	of momentum is ***p***; ○ The formula to calculate momentum is $\boldsymbol{p=mv}$, and the unit of momentum is kg·m/s. ○ ○ How to define the direction of the momentum; ○ Remember the unit of momentum.	momentum.
25	Worksheet	● Teacher will provide the worksheet to practice the numerical problem on the momentum. ● Teacher will see observe the work while they solve the practice question and guide them accordingly.	● Student will receive the worksheet to practice the numerical problem solving on the momentum. ● Student will show their individual work to teacher and receive or ask question
5 minutes	Whiteboard; Worksheet.	**<u>Closure</u>** ● Summarize and review the concepts learnt in this class using concept map and notes on the handouts. ● Ask students if they have questions about the concepts learnt. ● Then respond to students' questions. ● Give assignment to students,	Students will: ● Together with teacher review what learnt in this class. ● Ask questions if any. ● Write down requirement of assignment.
Extensions:		1. For high achievers: Provide challenge numerical problems involving momentum in one dimension.	
Differentiation:		1. Use the PowerPoint presentation, for increase/decrease the size of fonts for students having difficulty seeing content on the white board and vice versa. 2. Use of audio-visual to address the need of ELL learners and in general for all students. Students who have auditory or visual impairment will also benefit from this. 3. Decreasing the amount of practice work for the student facing anxiety issue and difficulty understating the concept as well as on recommended for IEP. 4. ELL students will be encourage to take the practice work at home if they need more time to finish the classwork.	

Lesson # 1 **Worksheet on Momentum**

Momentum (F)

The momentum of this snowball increases because two factors increase as it rolls down the hill. What do you think the two factors are?

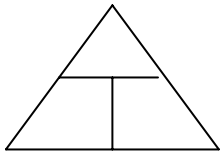
……

……

……

Momentum can be calculated using this equation:

Momentum = …… x ……



The units of momentum are …….

Questions

Calculate the momentum of

a) An athlete of mass 60 kg running at a velocity of 10 m/s.

……

b) A car of mass 800 kg traveling at a velocity of 30 m/s.

……

c) A ship of mass 20000000kg traveling at a velocity of 5 m/s.

……

d) A plane of mass 80 000 kg traveling at a velocity of 300 m/s.

……

e) A rocket of mass 100 000 kg traveling at a velocity of 2000 m/s.

……

f) A football of mass 500g traveling at a velocity of10m/s.

……

(Source : https://www.tes.com/teaching-resource/momentum-f-and-h-worksheets-6342287)

Additional question on Momentum for model problem solving and can be used as extension (challenge questions)

1. Calculate the momentum of a 1.60 x 103 kg car traveling at 20.0 m/s.
2. Calculate the momentum of a 2.50 x 103 kg truck traveling at 110 km/h.
3. How fast is a 1.50 kg ball moving if it has a momentum of 4.50 kg.m/s?
4. A 75.0 g ball is rolling at a speed of 57.0 cm/s. Calculate the ball's momentum.
5. A 5.00 kg ball accelerates at a rate of 2.00 m/s2 for 1.50 seconds. Calculate the ball's momentum after the acceleration.
6. A 2.00 kg rock is dropped from the top of a 30.0 m high building. Calculate the ball's momentum at the time that it strikes the ground.
7. A 1.00 kg rock is thrown up into the air from ground level at a speed of 8.00 m/s. The ball travels up to a maximum height, then returns to the ground. Calculate the rock's momentum as it strikes the ground.
8. A 1.50 kg rock is thrown up into the air from ground level, reaches a maximum height of 7.00 m, then returns to the ground. Calculate the rock's momentum as it strikes the ground.

Lesson 2: Impulse

Rationale:

Students have learnt the concept of momentum, which is product of mass and velocity. Momentum is a vector quantity that has the same direction as the velocity of the object. Students are now set to explore the new concept in the unit of momentum known as impulse-momentum theorem. The lesson also serves as the extension to the concept of momentum in particular the change in momentum. Students will learn to derive the equation for the impulse in terms of newton's 2nd law of motion and would be able to appreciate the change of formula of the equation of change in momentum.

Lesson Objectives and Content Outcomes:

Students will be able to:

- Define Impulse
- Understand that Impulse is a vector quantity.
- Describe impulse is the change in momentum of an object
- Relate impulse as a change in momentum ($\Delta \mathbf{p} = m\Delta \mathbf{v} = \mathbf{F}\Delta t$)
- Recognize the relation between the newton's 2nd law of motion to derive the impulse equation
- Solve and practice numerical problem based on the impulse equation.

Teaching Schema

Time	Materials	Teacher Activities	Student Activities
5 min.	Whiteboard	**Administrative Task:** ● Check the attendance; ● Teacher will explain the class agenda.	● Participate in attendance check
15 min.	Presentation using PowerPoint slides (https://www.slideshare.net/wjerlinger/041408-momentum-and-impulse);	**Warm up and review:** Teacher will: ● Review the concept of momentum, forces and vectors; ● Derive the expression for impulse from Newton's 2nd law; ● Described the impulse equation;	Students will: ● Participate in the discussion and review material from previous class; ● Compare and contrast the momentum and impulse equation; ● Participate in question and answer

	Handouts;	***F*Δ*t*=*m*Δ*v*=Δ*p***(change in momentum and vector quantity); ● Make the unit description.	following the impulse derivation.
25 minutes	Projector; Momentum package.	**Practice:** ● Problem solving using the impulse equation on ✓ Momentum ✓ Impulse ✓ Net force ✓ Time ● Group work on momentum Package, impulse page.	Student will work in pairs on the problem solving (worksheet on Impulse)
30 minutes	Video on Spiderman train stopping video. (https://www.youtube.com/watch?v=yRhRZB-nqOU)	**Assessment:** This video activity will form a part of formative assessment of the concept that the student has learned today. The teacher will ask a guiding question to facilitate the discussion following the video. The guiding question is: What is the force that Spider Man exerts on the train? There are multiple ways of finding this out. Students who have found one way (e. g, using ***F*=*ma*** and finding a first) are encouraged to find the answer another way (Using impulse) Possible hints: -How long did it take him to stop the train?	Student will: ● Discuss the Spiderman video and corresponding question in pairs and then will be shared with the class; ● Each student will submit a written exit slip for the question asked in regards to video.

		-Over what distance was the force applied? Discussion: Is this reasonable considering the description of the superhero's powers (spiders can lift 15x their own weight)	
5 min.		**<u>Closure</u>** Teacher will ● Teacher will review the material learned during the class today; ● Answer any questions that student may have; ● Tell student about the next topic for the class; ● Remind of any prerequisite or preparation needed for the next class; ● Provide homework question to students.	Student will ● Write an exit slip after having discussion of the video analysis in their own words; ● Ask question on the topic learned ● Together with teacher, learn on the next topic of discussion and prior study material for next class/lab.

Lesson #2 **Worksheet On *Impulse***

1. A force of 20.0 N is applied to a 3.00 kg object for 4.00 seconds. Calculate the impulse experienced by the object.

2. A 1200 kg car traveling at 20.0 m/s speeds up to 30.0 m/s. What is the impulse experienced by the car?

3. A 1500 kg car accelerates from 55.0 km/h to 90.0 km/h. Calculate the impulse experienced by the car.

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4. A 1200 car accelerates from rest to 10.0 m/s in a time of 4.50 seconds. Calculate the force that the car's tires exerted on the road.

5. A 1500 kg car traveling at 80.0 km/h comes to a screeching halt in a time of 4.00 seconds. Calculate the force of friction experienced by the car.

6. A 1.00 kg ball traveling towards a soccer player at a velocity of 5.00 m/s rebounds off the soccer player's foot at a velocity of 8.50 m/s. If the time of contact between the ball and the player's foot was 2.00 x 10-2 seconds, what was the force that the foot applied on the ball?

7. A 1.50 kg rock falls from the top of a 10.0 m high building and strikes the ground below. Calculate the impulse experienced by the rock during its fall.

8. A 1.50 kg rock falls from the top of a 10.0 m high building and strikes the ground below. What is the force of the ground acting on the rock if it comes to a stop in 0.350 seconds?

Source

1. https://mrkremerscience.files.wordpress.com/2016/12/momentum-worksheet-2.pdf

Lesson 3: Impulse and Change in momentum

Rationale:

Students have learnt the concept of momentum and change in momentum through the concept of momentum. They have also learned the relationship between the change of mass and velocity and their equivalence representation using the force and time. This lesson will would provide students an opportunity to reinforce and demonstrate the learning by designing and conducting activity/experiment for the real life application such as studying or minimizing the impacts of the object for the safety consideration. Student will have chance to apply the concept of momentum and change in momentum for the real life events such as car crashes, airplane, parachute landings or minimizing the effects of impacts using momentum (impulse).

Objectives/Content Outcomes:

Students will be able to:

- Describe impulse is the change in momentum of an object
- Understand the content given in handouts
- Apply the concept of momentum in real life situation such as crash or collision

Teaching Schema

Time	Material/resources	Teacher activity	Student Activity
5 min.	Whiteboard; Seating Chart.	**Administrative Task:** Teacher will: ● Check the attendance;	Student will participate in attendance check.

		• Explain class agenda.	
30 min,	Smart Phone, Internet access, App link (padlet link for contribution and sharing) https://padlet.com/ashokpph/ac1e2b09ojt8	Introduction • Student will be asked to show their homework • Think-Pair-Share: Student will be able to share their answers to their peers and discuss if they find different or similar explanations to the question. • Student will have asked to share their answers by posting they answer using Padlet. The Padlet link will be provided to the student. • Teacher debrief on the findings of the students.	• Student will show up their work through the padlet provided • Student will be involved in Think-pair-Share activity on the question they have received on the Spiderman video activity. • Students will be asked to post their response to padlet in groups. • The padlet contribution and share will allow students to work in groups and will name their anonymous by keeping their identities private and this will enhance their confidence without any anxiety. • The padlet activity also used as adaptation as well as for the purpose of **formative assessment**
40 min	Lab Handout Lab report writing guide handout Lab rubric	Body (**40 min**) • **Egg Drop Experiment**: Student will be introduced to the lab experiment to demonstrate the impulse and change in momentum • Teacher will provide with handout of the experiment details.	Students will receive the following documents/handouts for review - Lab Handout - Lab report writing guide handout - Lab rubric • Student will be given time to familiar with activity by reading the handouts

		• Teacher will distribute handouts on the guidelines for the lab report writing. • Teacher will give the rubric and direct students' attention to the different elements of the rubric and for the assessment of lab experiment and lab report produced. • Teacher will ask to read the handout and ask the question to understand the experimental details.	• Student will be encouraged to ask question on the activity handouts. • Student will ask to start thinking about building their rough draft (Sketch) device/equipment and encourage consulting with teacher. • Student will show sketch of their design/equipment for the activity for the approval of the design.
5 min		Closure • Students will have asked to confirm the group they will be working with. • Asking student to come prepared and bring the structure needed for the activity.	Student will be able - Form the group - Inform the teacher members of the working group. - Able to get approval-in-principle for their design. **(formative assessment**)

Egg Drop Experiment

Engage

1. Inform students that they are going to play the role of Vehicle Safety Engineers. In order to design and build cars to help people safely survive auto accidents, the students are to design and build a device that will keep an egg from breaking after being dropped from a tall height. (A water balloon can be used as an alternative.)

Explore and Explain

1. Force to Break an Egg
    a. Ask students, "How much force can an egg withstand? Devise a test and carry it out." Students carry out the test and determine the force required to break an egg. (A water balloon can be used as an alternative.)

Elaborate

2. Materials Test
    a. Students design and carry out a controlled test to determine which material will best help their egg survive.
        i. Teacher says to students, "Based on the impulse equation, in order for an egg to survive an impact, should the collision take a longer time or a shorter time?" It may help to explicitly rewrite $Ft = \Delta mv$ into $F = \Delta mv/t$ (but with the t written underneath). Then substitute a small and a large number for t and have the students see what happens to the force. Or, this could be worked into the problem sets.
        ii. "Based on the answer to the question above, design a controlled test to determine which material would best increase or decrease time during a collision." Students are to base their test on materials in the T4T cart.
        iii. Students carry out the test.
        iv. Students explain, "Which material is best? Use evidence from your test to support your answer?"

Evaluate

3. The Egg Drop
    a. Main Question – Use the impulse equation to determine how much time is needed to safely bring an egg to rest from a tall drop.

4. Students gather their materials and construct their containers.

5. Teacher instructs students to think about what data will need to be collected
    a. Important data
        i. Mass of egg
        ii. Force to break egg (already determined)
        iii. Time of fall (alternatively, height of fall)

6. Teacher facilitates the egg drop from a tall height.

7. Lab Write-up
    b. Students write a formal lab write up
        i. To be determined/reported ($Ft=\Delta mv$) …
            1. Force to break an egg
            2. Mass of egg
            3. Final velocity of egg
            4. Velocity of egg just before impact
            5. Time it should take for an egg to safely come to rest (assuming no bounces)

        ii. To be discussed…
            1. A rationale for the materials they used (drawn from the Materials Test)
            2. Did your egg survive? In terms of the impulse equation, explain why/how your egg either survived or was cracked.
            3. Does the mass of a device matter? Why or why not.
            4. Would it be better to use a hard/solid exterior or a soft/malleable exterior for a device? Why? Give reasons.

Teacher's Guide for calculations in the Lab Write-up
We are looking for the time the egg needs to survive the crash from the impulse equation $Ft=\Delta mv$

Because the mass does not change we can rearrange… $Ft=m\Delta v$.

t = ? (we are looking for the time)

F = force to break an egg (measured from the force to break an egg test)

m = mass of egg

$\Delta v = v_f - v_i$

$v_f = 0$ (assuming no bounces)

v_i = the velocity at the beginning of the crash (the velocity at the end of the fall)

We will find this by analyzing the fall of the egg.

Analyzing the fall to determine the final velocity (the initial velocity of the crash) … $a = (v_f - v_i)/t$

$a = 9.8 m/s^2$ (we are assuming free-fall)

v_f = ? (We are looking for this. It will be the initial velocity of the crash)

$v_i = 0$

t = time for egg to fall to ground, measured by stopwatch

*During all activities teacher serves as a facilitator of student learning (i.e. student centered instruction). Most tasks should be completed by students after simple directions, or facilitated questions to enhance student learning.

Accommodations: All individual accommodations for students should be met with respect to your particular students and classroom dynamics and will vary from class to class and group to group. Facilitator should always differentiate instruction by providing the necessary blend of guidance and exploration for each student group and their specific needs.

Resource :

1. www.t4t.org/wp-content/uploads/.../MOMENTUM_and_IMPULSE-Egg_Drop.docx
2. https://stem.neu.edu/programs/ayp/fieldtrips/activities/eggdrop/
3. http://ypp.ucsd.edu/labs/EggDrop.pdf

Handout on Egg Drop Activity

TEAM MEMBERS: _____

TEAM NAME: _____

Using the listed materials, sketch a drawing of your egg drop device in the space below:

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Fill out the material order form with the Quantity (number of each item) and total cost for that item (Cost * Quantity). Add the totals to ensure you do not exceed $ 50.

YOU HAVE 50 TO SPEND. BONUS POINTS FOR SAVING $

Use the materials carefully, as they will not be replaced if you damage them.

Material	Cost ($)	Quantity	Cost x Quantity
Toothpick			
String			
Paperclip			
Straw			
Cotton ball			
Pipe Cleaner			
Rubber band			
Paper			
Cotton			
Newspaper			
Balloon			
Plastic Sheet			
	Total Cost =		

EXTENSION QUESTIONS:

1 - Describe how your device protected the egg from cracking. What material was most important in your design? What material that you used was least effective?

2 - Knowing what you know now, how would you improve upon your design to make it work better on the next try? Draw a picture if it helps!

3 - What material would you use in another design that you did not use today, and WHY?
It can be a material that was not offered.

4 – What things in nature are similar to this egg drop experiment? What things that humans use are similar to the egg drop experiment? How do these things work? For example, the helicopter seeds that some trees use to disperse their seeds with the wind. What else is there?

ACTIVITY PREPARATION CHECKLIST: EGG DROP Experiment

Handouts: Instructions + Order Form / Questions (double-sided)
Materials:

QTY	**ITEM**	**11/9**					
.75 / pp	Eggs (1 per 2 ppl + extras)						
1 / pp	Sandwich bags						
4	Toothpicks						
4	String						
4	Paperclips						
4	Straws						
5	Cotton Balls						
5	Pipe Cleaners						
5	Rubber Bands						
5	Paper						
4	Balloons						
1	Newspapers						
1	Plastic Sheets						

ADDITIONAL: Scissors, Tape, Pencils,

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Guidelines for Activity/Laboratory Report Writing

- **Prelab:** Before coming to the lab each student must be prepared. It is expected that each student has completed all pre-lab activities such as reading the lab handout and/or relevant material in the textbook or answering assigned questions.

- **Paper** 8½" x 11" (21.5 cm x 27.5 cm) white lined paper or letter paper. The report should be single spaced with 12 pt Times Roman font. There should be a 1-inch margin on all sides of the pages.

- **Title Page** The title page should include the following items: a title centered 1/3 from the top of the page; an identification containing the student's name, lab partner's name, course number, due date, and teacher's name located at the bottom right hand corner of the page.

- **Objective** The objective is a concise statement outlining the purpose of the activity/experiment. e.g. To determine the boiling point of H_2O

- **Introduction** The introduction should contain any prior knowledge on which the experiment is based; including an explanation of principles, definitions, experimental techniques, expected results (hypothesis), theories and laws.

- **Materials** The materials section is a list of all equipment, reagents (chemicals), and computer programs that were used to complete the experiment. Drawings of the apparatus setup should be included in this section if needed.

- **Procedure** The procedure is a detailed statement (step by step) of how the experiment was performed such that the experiment could be repeated using your report. Safety precautions which were followed should be stated. The procedure must be written in the impersonal (3rd person) past tense:
  e.g. We are taking the temperature every 2 minutes (Incorrect).
  The temperature was taken every 2 minutes. (Correct)

- **Results** This section may consist of quantitative and/or qualitative observations of the experiment.

- **Quantitative Results**
  Graphs and Tables: Present the graphs and table as required.
  Calculations: ALL calculation should be included.

- **Qualitative Results**

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Observations: This is a qualitative written description and/or sketch of what was seen during the experiment. It may be in the form of a table or simply a written description.

- **Conclusion** The conclusion is a concise statement that answers the objective. The result of percent error and/or percent yield should be discussed and compared with known results. A portion of the conclusion should be dedicated to error analysis which discusses any possible sources of error that may have contributed to the percent error or yield. The conclusion should be written in the impersonal past tense.

- **Literature Cited:** Any information borrowed from another source which is not common knowledge must be cited within the text of the report as outlined in the "Directions for Preparing Formal Papers at Three Oaks" as provided by the English Department. All sources of information are to be listed in the Literature Cited section of the lab report in alphabetical order in the format suggested in the for mentioned section of the student agenda. This section should be on a separate final page of the report.

- **Questions** Although questions are not part of a formal lab report, they should be answered on a separate sheet of paper and attached to the report where applicable.

IMPORTANT REMINDERS FOR A LAB REPORT

1) Spelling
2) Significant figures and units regarding measurements and calculations
3) Avoid personal pronouns
4) Headings should stand out and each section should be separated by 1 line
5) Neatness counts -> use rulers when needed (especially when using tables and graphs

Source:

1. Guidelines adapted from http://www.edu.pe.ca/threeoaks/departments/science/resources/Formal_Lab_Report_Guidelines.pdf

Example of potential Rubric adapted for the assessment activity/laboratory report.

Lab Report Rubric	3 Points	2 Points	1 Points	0 Points
Purpose of the experiment is clearly stated.				
Procedure directly addresses the purpose.				
Procedure is written in such a way that is could be easily repeated by another person.				
Measurements recorded correctly.				
Data represented clearly and neatly.				
Data meaningful and reliable.				
Calculations organized clearly.				
Calculations are done correctly, including the use of units and significant figures.				
Conclusion addresses the purpose				
Conclusion relates to the experimental results.				
All lab partner(s) contribute to the experiment.				
Proper laboratory techniques were demonstrated				
Lab area cleaned at the conclusion of the experiment.				
All safety rules were observed and followed.				
Total Points: _____/_____				

Source:

1. https://ef42ac3c-a-373cf85f-s-sites.googlegroups.com/a/riverbendschools.net/gates-science/physical-science-lab-manual/Lab%20Report%20Rubric.png?attachauth=ANoY7coZ0PrGWsPLEupcW0OsexnJxTaOArJZdskavFFeW6LIPYu41KSnxteBG7LDCXGOU4hPqRf1PDz4qVkQUpvgIywwWuGbVVrZFay0jiG6xK4AbRXqvDN1LKuDsyb2bKmKuGjGRnXZIbPD5zp2k83pad58sGhjFJyGzlFLDONWwvLsOvCOhXcCmKBf2d32vqqHxn1nUXHiMRdEu_WoZVqdaVJBS7K11p-627OjDQWBS51b3AsbZm-CCFK70pMDK1wn7uzdLBC8F2hXQRNeXx6VhGKyIsA3ug%3D%3D&attredirects=0

Lesson 5: Conservation of momentum

Class description:

Students have learnt momentum and impulse in previous lessons and now proceeding into the lesson on the conservation of momentum. Specifically speaking, this lesson will focus on the momentum of an isolated system before and after collision. The definition of system, collision, and the law of conservation of momentum will be discuss with examples.

Objectives/Content Outcomes:

Students will be able to:

- Define system, objects in the system, and collision;
- Describe objects' status before and after collision using momentum;
- Understand the momentum of the isolated system is conserved before and after collision;
- Describe the law of conservation of momentum;
- Solve collision problems using law of conservation of momentum.

Teaching Schema:

Time	Materials	Teacher Activities	Student Activities
5 min	Whiteboard; Seating chart.	Administrative Task: Teacher will: ● Check the attendance; ● Collect lab report; ● Explain class agenda.	Student will ● Participate in attendance check. ● Submit lab report.
20 min	Whiteboard; PhET: https://phet.colorado.edu/en/simulation/legacy/collision-lab	Warm up and Review: Teacher will ● Use PhET simulation to show students the mass and velocity of each object in a system before and after an elastic collision; ● Ask students to calculate the momentum of each object in the system before the collision and then add them together to obtain a total	Activity: PhET Students will ● Use PhET to simulate collision between two balls; ● Calculate momentum for each ball in the system before and after collision; ● Calculate the total momentum

		momentum before collision; ● Ask students to calculate the momentum of each object in the system after the collision and then add them together to obtain the total momentum after collision; Emphasize to students momentum is vector quantity with unit kg·m/s.	before and after collision; Discuss, based on previous learnt knowledge, the direction and the unit of the momentum.
35 min	Whiteboard; Handouts; Physics 11 Textbook; 1. Newton's cradle YouTube: https://www.youtube.com/watch?v=JadO3RuOJGU 2. Carts Collision Animation: http://www.cabrillo.edu/~jmccullough/Applets/Flash/Mechanics/AirTrack.swf	**Lecture/Notes for Law of Conservation of Momentum:** Transition: Teacher will: ● Explain the concepts of system and collision using the example from PhET; ● Give more examples of collision ○ Newton's cradle (using a physical Newton's cradle or video from YouTube); ○ Carts on track collide with each other (using lab equipment or animation); ● Give students time to discuss, in pair, the change of total momentum before and after collision in all above examples.	Students will: ● Write down notes for system and collision; ● Calculate total momentum before and after in teacher's examples; ● Discuss, in pair, if there is change in the magnitude of the total momentum before and after.
		Teaching: Teacher will ● Introduce the Law of Conservation of Momentum; ● Explain the results from all examples above to show that the momentum of the system is conserved before and after the collision; ● Give examples (problems from handouts or worksheet) to show how to use the law to solve problem. ●	Students will ● Write down notes on the blank of the handouts; ● Get acquainted with the Law of Conservation of Momentum; ● Apply the Law of Conservation of Momentum to all above examples and new problem solving examples.

15 minutes	Quiz worksheet	**Assessment:** Teacher will: ● Assess students' understanding using small quiz (please see quiz questions attached).	Students will: ● Solve the questions in the quiz (10-15 minutes).
5 minutes	Whiteboard; Worksheet.	**Closure** Teacher will: ● Summarize and review the concepts learnt in this class using notes on the handouts; ● Ask students if they have questions about the concepts learnt; ● Then respond to students' questions. ● Distribute assignment (unit review worksheet) to students.	Students will: ● Together with teacher review what learnt in this class; ● Ask questions if any.

Lesson 5: **Quiz questions on Conservation of Momentum**

1. A 2.50 kg ball moving at 7.50 m/s is caught by a 70.0 kg man while the man is standing on ice. How fast will the man / ball combination be moving after the ball is caught by the man?

2. . A 1200 kg car traveling North at 20.0 m/s collides with a 1400 kg car traveling South at 22.0 m/s. The two cars collide and entangle. What is the resulting velocity of the wreckage?

3. A 5.00 kg ball hits a 75.0 kg man standing at rest on ice. The man catches the ball. How fast does the ball need to be moving in order to send the man off at a speed of 3.00 m/s?

4. A $1.50 \times 10_3$ kg car traveling at 100 km/h South collides with a $1.20 \times 10_3$ kg car traveling North at 100 km/h. The heavier car continues to move South after the collision, but slows to 25.0 km/h. How fast is the lighter car moving after the collision?

5. A 92.0 kg football player running at 6.50 m/s North collides with an 85.0 kg football player running at 6.00 m/s South. The 92.0 kg football player continues moving at a velocity of 2.00 m/s after the collision. What is the velocity of the 85.0 kg football player after the collision?

6. A 75.0 kg man is standing at rest on ice while holding a 4.00 kg ball. If the man throws the ball at a velocity of 3.50 m/s forward, what will his resulting velocity be?

7. A person holding a 15.0 kg gun containing one 50.0 g bullet is riding on a train that is traveling at 75.0 km/h East. If the man fires the gun and the bullet moves with a velocity of 350 m/s East (relative to the train), what is the velocity of the gun relative to the ground?

8. Calculate the velocity of the rifles recoil after firing ?

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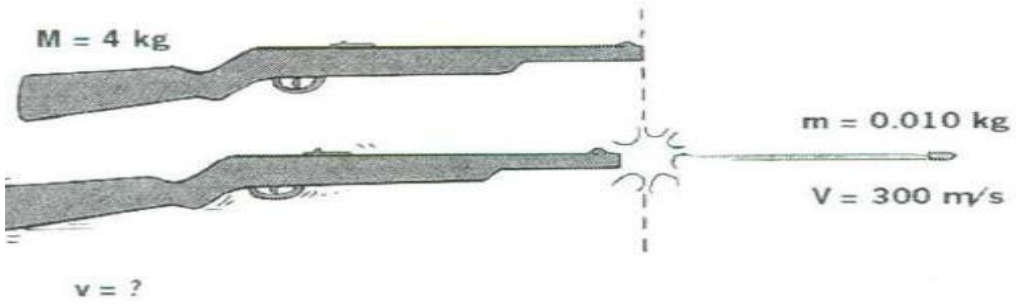
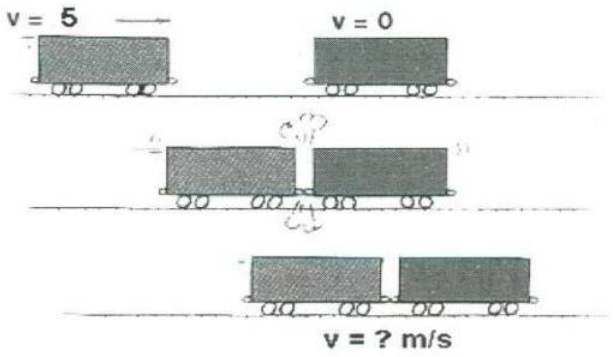


9. During a goal-line stand, a 75 kg fullback moving eastward with a speed of 10 m/s collides head-on with a 100 kg lineman moving westward with a speed of 4 m/s. The two players collide and stick together, moving at the same velocity after the collision. Determine the post velocity of the two players.

10. A 6000 kg railroad car moving at t 5 m/s collides into a stationary car with a mass of 4000 kg. if they couple together after the collision, what will be their combined velocity immediately after impact?



Source :

1. https://fc.deltasd.bc.ca/~favyee/FOV2-000747F3/FOV2-000ADB30/Momentum%20Conservation%20WS2%20Answers.pdf?Plugin=Loft
2. https://mrkremerscience.files.wordpress.com/2016/12/momentum-worksheet-2.pdf

Lesson 9: Review of Concepts and Problem solving

Rationale

Students have learnt momentum, impulse, and conservation of momentum in previous lessons and now proceeding into the review lesson. This lesson will be able to provide student's an opportunity to practice and introduce them to various formats of the question in very interactive, find and stress free way. Specifically, this lesson will help students review the concepts learnt in this unit and also help them prepare the unit test.

Objectives/Content Outcomes:

Students will be able to:

- Solve at least 80% conceptual questions and problem solving questions independently on the review worksheet.
- Understand the concepts learnt in this unit better through the review session and fun based activity.
- Understand the procedure and purpose of the lab done in this unit better through this review session.

Teaching Schema:

Time	Materials	Teacher Activities	Student Activities
5 minutes	Whiteboard; Seating Chart	**Administrative Task:** Teacher will: ● Check the attendance; ● Explain class agenda;	Student will ● Participate in attendance check; ● Submit or show to the teacher the assignment.
15 minutes	Whiteboard.	**Warm up and Review:** Teacher will ● Review key concepts, in detail, of this unit: momentum, impulse, and the conservation of the momentum; ● Clarify misunderstanding/confusion in students' understanding of these concepts (based on results of formative and summative	● Student will ask question if they have some questions on the concepts.

		results gathered from previous lessons).	
25 min.	Whiteboard; Review worksheet; .	**Explain questions in the review worksheet:** Teacher will ● Go over each questions on the worksheet; ● Give more practice questions if students feel confuse about any concepts learnt in this unit; ● Announce correct answer for the worksheet; ● Require student self-evaluate/score their answers to the questions on worksheet; ● Allow students discuss, in pairs, the learning experience for this unit; ● Circulate in the classroom to help students.	Students will: ● Go over each questions together with teacher; ● Ask for help from teacher if there is any confusion about the concepts; ● Self-evaluate answers on the worksheet; ● Share, in pair, personal learning experience for this unit.
30 min.	Quiz, Internet access	**Assessment:** Teacher will: ● Assess students' understanding using Jeopardy quiz as appear on TV. https://jeopardylabs.com/play/momentum-and-impulse-jeopardy ● Teacher will divide the whole class into the six groups to play the jeopardy game on the review of the unit.	Students will: ● Participate and solve the questions in the quiz. ● This activity will be fun based learning and reviewing of the concept. Students who have anxiety or fear working individually will greatly benefits. This is one of the differentiations adopted for the needs of diverse ability students.
5 Min.	Whiteboard	**Closure**	

		Teacher will: ● Ask students if they have questions about the concepts learnt; ● Make announcement that next class is the unit test; ● Then respond to students' questions.	Students will: ● Ask questions if any; ● Write down requirement of assignment.

Review on Momentum, Impulse and Conservation of Momentum

1. A Sample of Jeopardy Quiz/game to review the concepts of Momentum in one dimension

Momentum,Velocity and Mass	Impulse, Force and Time	Impulse and Momentum	Law of conservation of Momentum	Isolated or Not
100	100	100	100	100
200	200	200	200	200
300	300	300	300	300
400	400	400	400	400
500	500	500	500	500

Snipping Tool

Team 1	Team 2	Team 3	Team 4	Team 5
0	0	0	0	0
+ -	+ -	+ -	+ -	+ -

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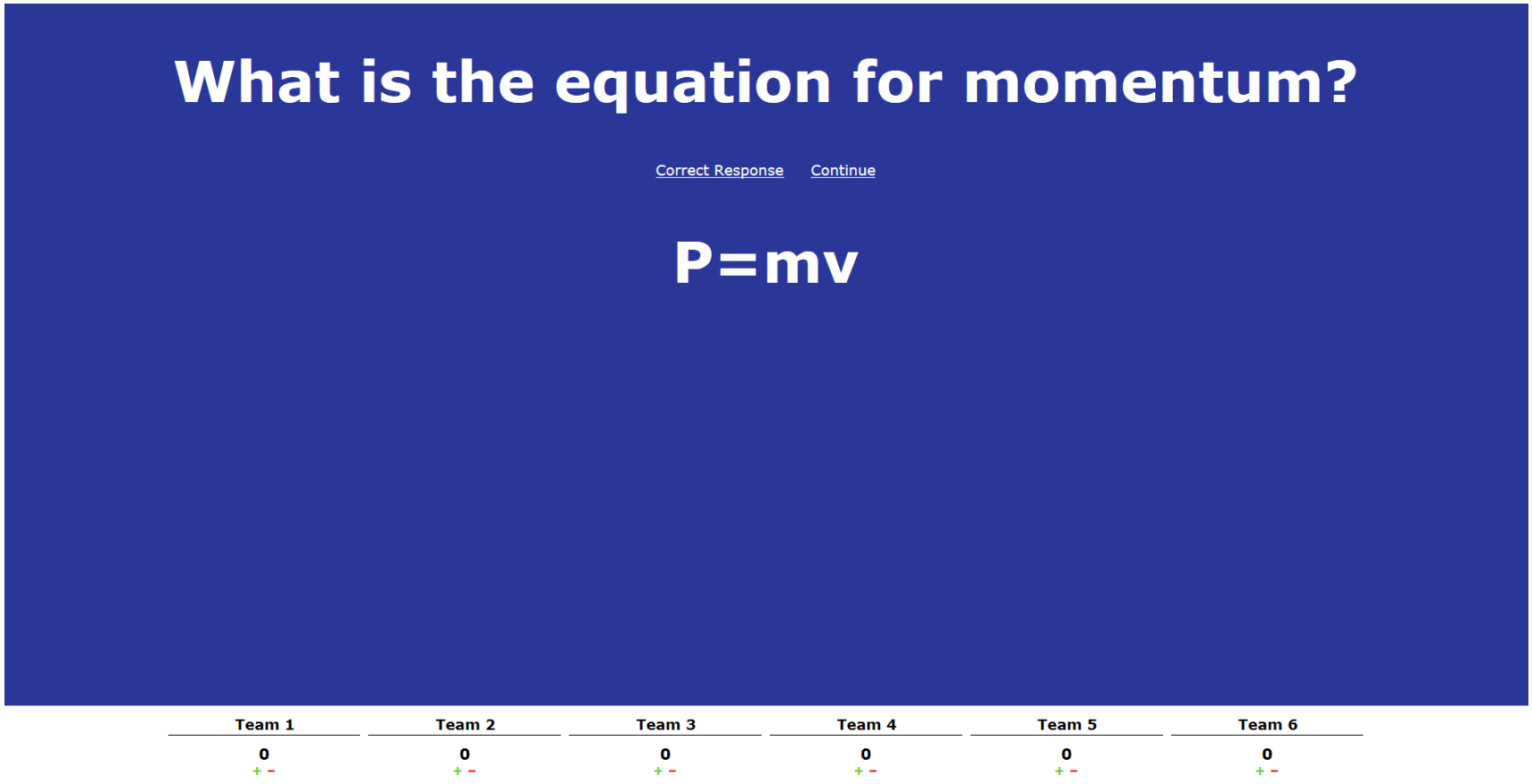
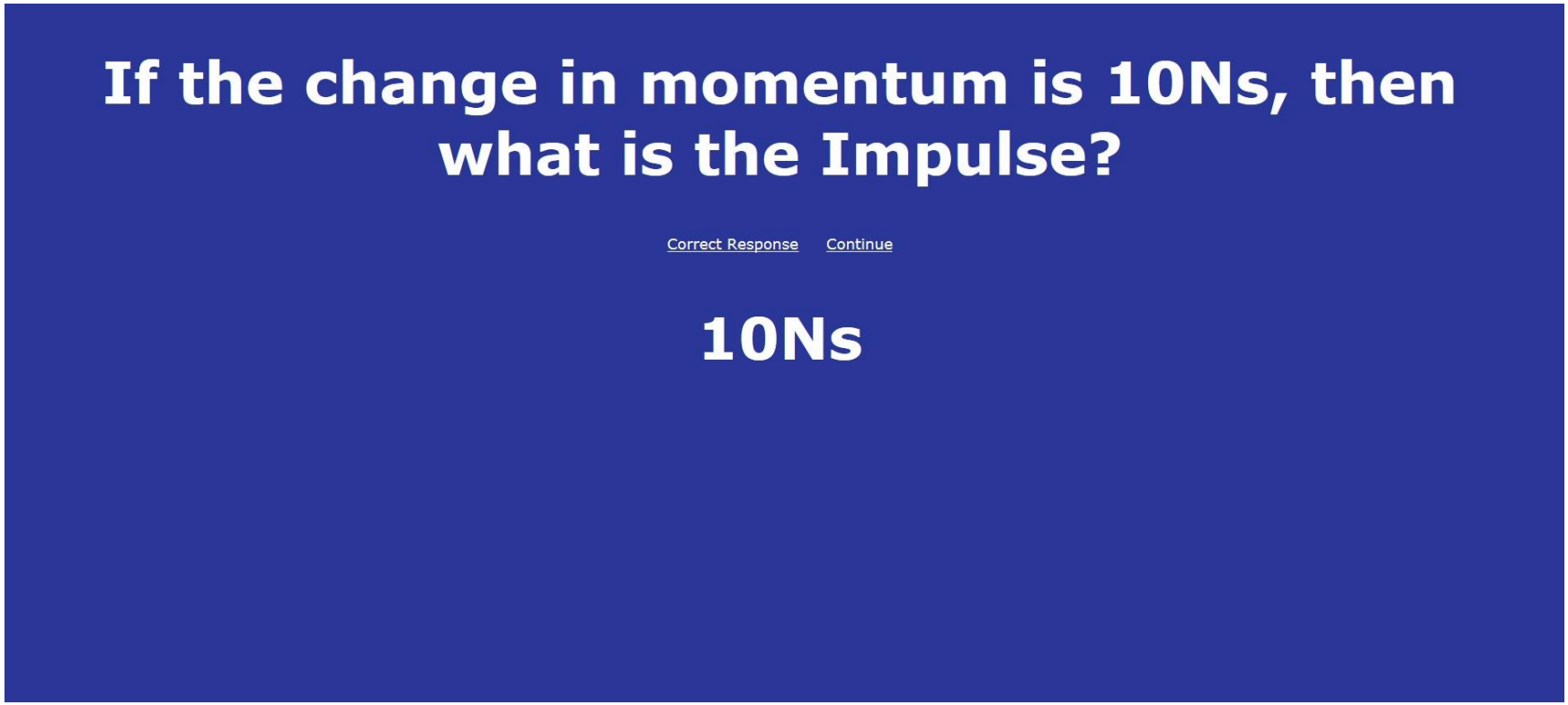
2. Example of conceptual question in Jeopardy quiz/game on Momentum



3. Example of Numerical Problem solving in Jeopardy quiz/game on Momentum



Source

1. https://jeopardylabs.com/play/momentum-and-impulse-jeopardy

Sample of Review Question on Momentum

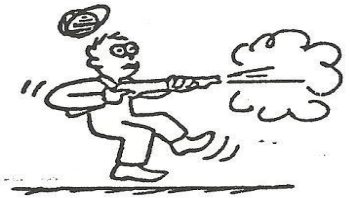
1. A moving car has momentum. If it moves twice as fast, its momentum is _____ as much.

2. Two cars, one twice as heavy as the other, move down a hill at the same speed. Compared to that of the lighter car, the momentum of the heavier car is _____ as much.

3. The recoil momentum of a gun that kicks is

   (more than) (less than) (the same as)

   the momentum of the bullet it fires.



4. Suppose you are traveling in a bus at highway speed on a nice summer day and the momentum of an unlucky bug is suddenly changed as it splatters onto the windshield.

   a. Compared to the force that acts on the bug, how much force acts on the bus?

      (more) (the same) (less)

   b. The time of impact is the same for both the bug and the bus. Compared to the impulse on the bug, this means that the impulse on the bus is

      (more) (the same) (less)

   c. Although the momentum of the bus is very large compared to the momentum of the bug, the *change* in momentum of the bus, compared to the *change* of momentum of the bug is

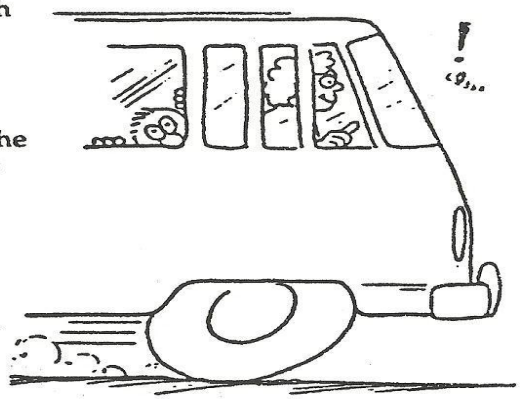
      (more) (the same) (less)

   d. Which undergoes the greater acceleration?

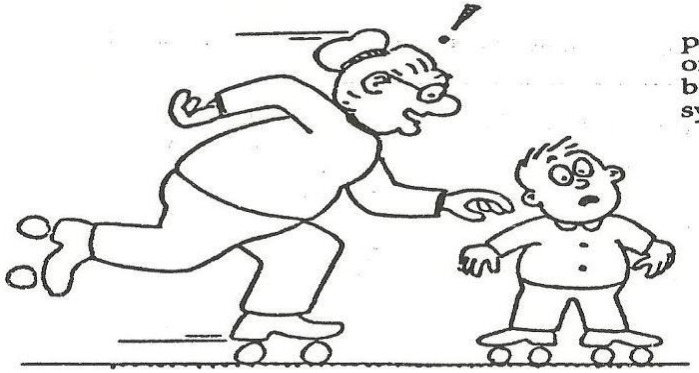
      (bus) (both the same) (bug)

   e. Which, therefore, suffers the greater damage?

      (bus) (both the same) (the bug of course!)



5. Granny whizzes around the rink and is suddenly confronted with Ambrose at rest directly in her path. Rather than knock him over, she picks him up and continues in motion without "braking."



Consider both Granny and Ambrose as two parts of one system. Since no outside forces act on the system, the momentum of the system before collision equals the momentum of the system after collision.

a. Complete the before-collision data in the table below.

BEFORE COLLISION	
Granny's mass	80 kg
Granny's speed	3 m/s
Granny's momentum	_____
Ambrose's mass	40 kg
Ambrose's speed	0 m/s
Ambrose's momentum	_____
Total momentum of Granny + Ambrose	_____

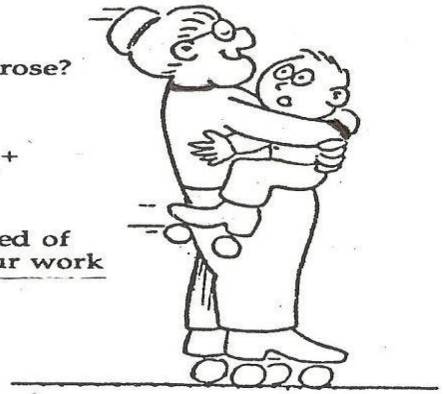
b. After collision, does Granny's speed increase or decrease? _____

c. After collision, does Ambrose's speed increase or decrease?
_____

d. After collision, what is the total mass of Granny + Ambrose?
_____

e. After collision, what is the total momentum of Granny + Ambrose? _____

f. Use the conservation of momentum law to find the speed of Granny and Ambrose together after collision. (Show your work in the space below.)



New speed = _____

Source

1. http://blog.wsd.net/bmeaders/files/2012/01/7-MomentumWORK-PACKET.pdf

Momentum: Review Worksheet questions for Differentiated learner and Instructions

Momentum

Momentum = mass X velocity

The units of momentum are kg m/s

Choose your own confidence level and calculate momentum.

Easy	Medium	Hard
If a ball of mass 1.5 kg travels at a velocity of 1.6 m/s what is the momentum?	Calculate the velocity of a boy with a mass of 5 kg and has a momentum of 6 kg m/s.	These questions ask you to state which has the largest momentum.
What are the units of momentum?	Calculate the velocity of a dog with a mass of 50 kg and with a momentum of 2 kg m/s.	A dog m= 30 kg, v = 50 m/s A cat m= 15 kg, v = 50 m/s
Calculate the momentum of a boy who's mass is 55 kg if he travels at a velocity of 6 m/s.	What is the mass of a man if his velocity is 50 m/s and his momentum 2 kg m/s?	A boy has a mass of 60 kg and a girl has a mass of 45 kg they both travel at 20 m/s.
What is the momentum of a car with a mass of 1000 kg if the car is traveling at 60 m/s?	What is the mass of a car if the velocity is 60 m/s and the momentum 3000 kg m/s?	A car has a mass of 2000 kg and a bike has a mass of 1500 kg, they both travel at 60 m/s.
What is the momentum of a car with a mass of 2000 kg if the car is stationary?	Calculate the momentum for a woman if her mass is 60 kg and her velocity is 50 m/s.	Which has the larger mass? A man with a velocity of 60 m/s and momentum of 80 kg m/s or a woman with a velocity of 50 m/s and momentum of 100 kg m/s.
If a cat has a mass of 20 kg and chases a bird at 30 m/s what is	What is the momentum of a bike if the mass is 1000 kg and the velocity is 80	A lorry hits a car. The lorry has a mass of 250 kg and travels at 80 m/s. The car has a mass of

the momentum of the cat?	m/s?	100 kg and is stationary. What is the momentum of the lorry and car? What will happen to the car?
A plate falls to the floor, the plate has a mass of 0.2 kg and falls with a velocity of 20 m/s what is the momentum of the plate?	If a fish has a mass of 20 kg and travels at 50 m/s what is the momentum of the fish?	A horse has a mass of 150 kg and a speed of 20 m/s. A pony has a mass of 100 kg and has a momentum of 40 kg m/s. Calculate the momentum for the horse and the velocity of the pony.

Source

1. https://www.tes.com/teaching-resource/momentum-differnetiated-questions-6178123