Lesson Title	Pinewood Derby Velocity Test
Length of Lesson	Two or Three 50 minute class periods
Created By	Adam Lenz
Subject	Physical Science
Grade Level	7th Grade
State Standards	1a,c; 2e,f
DOK Level	2,3
DOK Application	Predict, Compare, Hypothesize, Draw Conclusions.
National Standards	Inquiry – recognize the relationship between explanation and evidence Physical Science – describe the effects of an objects motion and the forces acting upon it.
Graduate Research Element	Using velocity to calculate stream discharge in the same way the students will calculate speed of their cars.

Student Learning Goal:

- As part of the Mississippi State Standards for 7th grade science students must learn to describe effects on an object in motion and the forces acting upon. The goal of this unit is to introduce to the students ideas about mass, gravity, and inertia. The object of this lesson is to teach students how to calculate velocity of their derby cars by recording the distance travelled and the time or travel, while also introducing concepts of inertia, and aerodynamics.

- National Standards:

  Inquiry - recognize the relationship between explanation and evidence
  Physical Science - describe the effects of an objects motion and the forces acting upon it

Materials Needed (supplies, hand-outs, resources):
Student groups will need a pinewood derby kit with body style of their choosing, including wooden body, wheels, and axel. Each group will also be given 6 metal washers to be mounted to their derby car and glue for mounting, handout with a blank data recording sheet for recording and calculating velocity, stopwatches for timing the cars, and a tape measure for measuring the distance. Students will also be able to use markers and sticker decals of their choosing.

Lesson Performance Task/Assessment:

- One day one of the lesson plan students will be given a short description of the lesson and concepts of the lab. The duration of the first day students will be divided into lab groups of approximately three students, each group will be given materials and they will have the 45 minute period to design and build their derby car. Each group will be able to choose a pre-cut body, add metal washers for weight, and color their vehicle to their liking.
- Day two of the lab will students will perform the derby "race". Each group will individually have three runs of their car down a ramp. Each run will be time, and the distance travelled will be recorded. Students will then have to calculate the velocity of each run for their own vehicle and average the three runs to determine their average velocity.
- At the end of day two or beginning of day three (time permitting) there will be a short in class discussion about what cars went further and faster and why. As a classroom we will look at the faster cars and compare them (discussion style) to the slower cars. To conclude the lab students will be given a few short questions on the handout need to be answered to determine their understanding of the discussed material.

Lesson Relevance to Performance Task and Students:
The lesson will help students be able to make connections between time, distance, and velocity. They will also be able to use the cars design and concepts of inertia to determine what makes the derby cars travel faster or farther.

Anticipatory Set/Capture Interest:
A short video of racing cars can be shown prior to class to capture the interest of students and possible give them ideas about how they want to construct their own vehicle.

Guided Practice:

- The instructor will give a short talk about how velocity relates to distance and time. Afterword the instructor will give talk about the directions for the lab and handout the derby car kits. The instructor will help give ideas and guide the students through their building process for the rest of the day.
- On day two the instructor will give another short talk about the directions for the day, give each group a data recording sheet, and assist each group with the derby car runs.
- At the conclusion of the runs the instructor will lead the class in a short discussion about the faster derby cars, and discuss further enrichment opportunities and concepts, and handout with questions to conclude the lab.

Independent Practice:

In small groups of 3-4, students will design and build derby their own derby cars. Students will be able to choose what type of body they want to use and where they want to distribute the extra weight. One day two students will record the times, and distances of each of their group's derby car runs and calculate an average distance and velocity.

Remediation and/or Enrichment:
Remediation will consist of a closer guided practice with students in smaller groups so that the basic concepts of the lab can be grasped through a more individual, hands-on approach. Enrichment learning will include a guided discussion about further enrichment concepts such as inertia and aerodynamics. The questions at the end of lab one will also include an opened ended question for students to be able to reflect on other factors that may have affected the velocity and how they might change their design.

Check(s) for Understanding:
A short in class discussion at the end of each day will give the instructor an idea if the students are following the ideas and concepts discussed along the way. The instructor will also be able to help guide the students through their simple velocity calculations and velocity averages at the end of the derby car runs. Answering a few short questions on the handout to conclude the lab will let the instructor know if students grasped the concepts of the lab.

- Why did particular cars go faster/slower?
- What would the result be if you distributed weight in different areas of the car?
- What elements/materials would you choose to change if you had the option?

Closure:
- Students will fill out data sheet and answer post-lab questions.
- Students will discuss further enrichment concepts.

Possible Alternate Subject Integrations:
- Mathematics (Algebra)
- Aerodynamics
- Friction
- Inertia

Teacher Notes:
Handouts and should be distributed at appropriate times during the lab so that students are not distracted during the introduction of the experiment. The instructor will need to evaluate students' progress throughout the design and experiment each day to manage

time and post-lab discussion. Depending on time and money and availability instructors may choose to utilize different material for the construction of their cars. Instructors will also need to have in mind the ability level and mechanical skills of the students before allow them to build cars on their own.