***State Standards addressed for this activity:***

***S:PS3:11:1.8 Given information (graphs, data, diagrams), use the relationships between or among force, mass, velocity, momentum, acceleration to predict and explain the motion of objects.  
S:PS3:11:2.1 Interpret and apply the laws of motion to determine the effects of forces on the motion of objects.  
S:PS3:11:2.3 Apply the concepts of inertia, motion and momentum to predict and explain situations involving forces and motion, including stationary objects and collisions.***

Accident Reconstruction

**Part I: GROUP WORK**

**Student Instructions**

In this task you will be working in **groups** to analyze the information and data from a car accident. Following this group work, you will work individually to use the data to solve a set of problems and draw conclusions about what happened during the accident.

You will turn in the following documents to your teacher

* Problem Analysis (done in groups)
* Calculations and Conclusions (done individually)

You will be scored on the calculations and conclusions using the rubric provided.

**Accident Reconstruction Problem**

There is currently a lawsuit by the state of New Hampshire against Smith Forgeries and Guardrail Co. stemming from two separate accidents that occurred on Interstate 93 in Franconia Notch. In both accidents the cars broke through Smith’s guardrails that were installed as a safety measure. You have been tasked by the court to determine who was at fault; the drivers of the vehicles or the guardrail company.

Within your group each student will function in one of the following roles: ***Insurance Adjuster***; ***Police Officer***, ***District Court Judge***, ***Department of Safety Administrator***.   
  
The State of NH has provided a table of data that might prove helpful, or not. Brainstorm with your group the data you will need in order to solve this problem. Are there other pieces of information missing that you might need? Be sure to give your input in regards to your specific role. **As you try to solve this problem you may ask for specific “evidence cards” to help you.**

**Data Provided by the State:**

|  |  |  |
| --- | --- | --- |
|  | **Crash A** | **Crash B** |
| **Speed Limit** | 100 km/hr | 100 km/hr |
| **Skid Mark Length** | 126 m | 92 m |
| **Time of Squeal** | 3s | 2.75 s |
| **Time of Crashing sound** | 0.5s | 0.5 s |
| **Weight of Each Car** | 58,800 N | 73,500 N |

**Data Provided by Smith Forgeries and Guardrail Company:**

“Smith Forgeries and Guardrail Company guarantee that our guardrails will withstand an impact of 75,000N, far above the industry standard”.

**Problem Analysis**

**Please fill out the following two charts with your group. You will have 20 minutes.**

|  |  |
| --- | --- |
| What we know | What we need to know |
|  |  |

**Use the following chart to track the evidence collected from the evidence cards.**

|  |  |
| --- | --- |
| Additional Evidence Collected | Importance to which role? |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
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|  |  |
|  |  |
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|  |  |
|  |  |
|  |  |

**STOP**

**Part II: INDIVIDUAL WORK**

**Calculations and Conclusions**

**In order to draw a conclusion, you will need to solve the following calculations.**

1st you will need to find the velocity before the moment of impact by using the distance each car skidded and the time of the skid **[v = d/t]**

2nd you will need to convert these velocities from m/s to km/hr. You know that there are 3600s in 1hr and 1000m in 1km

3rd, you will need to determine how much mass each car has by using F=m**g**, where **g** is the acceleration due to gravity. **[Acceleration due to gravity = 9.8m/s/s]**

4th now you will have to determine how fast each car slowed down (its negative acceleration) by determining the change in velocity and how long it took to complete that change. **[a = vf – vi/t] or Δv/Δt (change in velocity divided by the change in time)**

Lastly you will need to determine the force of the impact each car felt by using **F=ma**.

**Based on your group discussion, the information on the evidence cards, and your calculations, draw a conclusion that answers the following questions.**

The guardrails are rated to withstand an impact force of 75,000N. Make a claim about whether the guardrails performed as predicted in each crash.

* How can you tell?
* Who is responsible for the vehicles going through the guardrails?
* How would Newton’s 1st and 3rd law help explain the crashes?

Justify your answer using evidence from above. Be sure to reference the relationship between or among force, mass, velocity, momentum, and acceleration to predict and explain the motion of objects.