Slide A

Navigate: Our Design Challenge

Turn and Talk

What are examples of locations, activities, or policies that put people, animals, or the environment at risk because of cars or driving?

Look over your Community Interview responses or your Engineering Progress Tracker for ideas.

→ Be ready to share your ideas with the class.

Brainstorm Problems in Our Community

With your group

Share your own new ideas along with ideas from the interview or your Engineering Progress Tracker.

Jot down notes on your *Design Challenge Organizer*.

1a. What is something in our community that might put some people more at risk than others because of cars or driving? *This could be a place, a policy, a technology or even a lack of technology.*

1b. What is something that has made you feel safer when you are driving, walking, or taking public transit?

Narrow Down to a Solvable Problem

With your group

Step 2, question 2: Use physics to help narrow our focus.

For three possible problems, note which models or science ideas connect to each one. Our models include

i. velocity graphs, reaction distance, braking distance
ii. force and changes in motion while braking, crumpling, or stopping
iii. conservation of momentum

Note: If you are having trouble deciding, your teacher can show you some **case studies** to help you narrow your options.

Narrow Down to a Solvable Problem

With your group

Step 2, question 3: Agree on one problem to prioritize. What seems most important or impactful to you?

Agree on one problem as a group, then describe or draw it. The questions in *a* and *b* may help you prioritize. *Discuss these as a group before* **or** *after you choose your problem*.

a. How widespread is the problem? How often does it occur? In what place(s) does it occur?

b. Identify details to help your team narrow to a specific location, policy, or safety system.

Get Quick Feedback from Peers

With a partner

Stand up with your *Design Challenge Organizer*, find a partner not in your project group.

Share your work in question 3 and get **TAG feedback**:

How to give TAG feedback: a) **Tell** something you like.

b) **Ask** a question *about scale or quantity of the problem.*

c) **Give** a suggestion. *What would you do or try?*

After one person shares and gets feedback (1 min), switch roles and repeat.

Slide F

Record Feedback from Peers

With your group

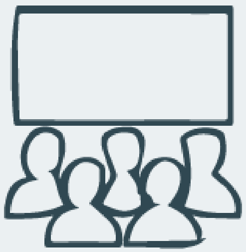
Share peer feedback on question 3.

- What did people like?
- What questions came up about scale or quantity?
- What suggestions did people give?

Take notes on at least one copy of question 3. Make sure to include ***details to narrow to a specific location, policy, or safety system***. Hand this in at the end of class.

Slide G

Navigate toward Developing Solutions



With your class

- What was interesting or challenging about *defining your design problem*?
- What might be interesting or challenging about *developing a solution* to this problem?

Next class, we will start developing solutions. Make sure to hand in one person's copy of the *Design Challenge Organizer* for feedback.

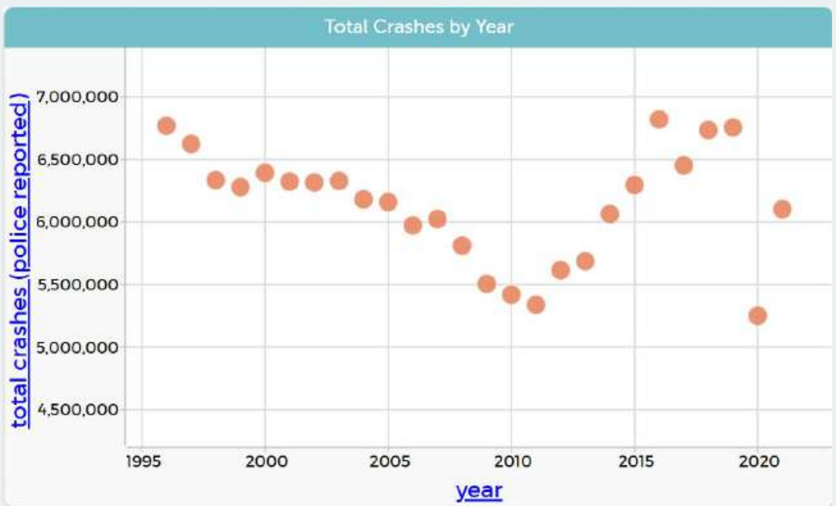
Slide H

Take Stock

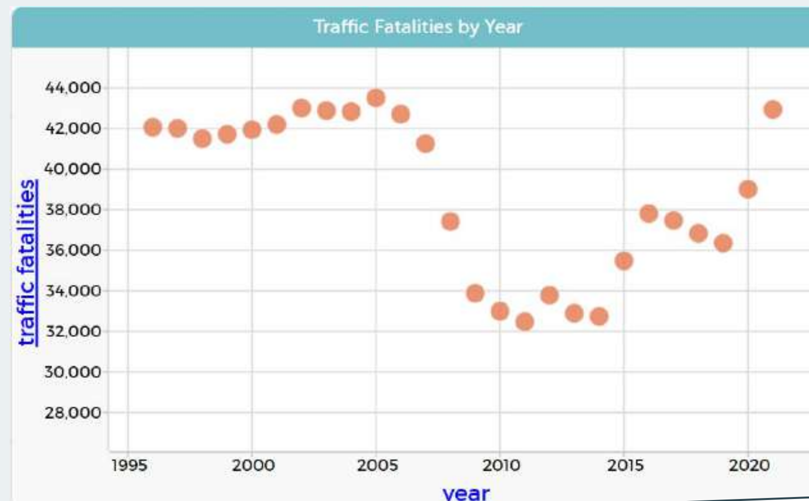
Turn and Talk

Can we apply our ideas about safety systems and other factors to explain these data trends?

Total Crashes by Year



Traffic Fatalities by Year



Images generated using CODAP (https://codap.concord.org/), developed at the Concord Consortium

→ Be ready to share your ideas.

Review Teacher Feedback

With your group

Review your work and feedback in the *Design Challenge Organizer*. Your team will have feedback on just one copy.

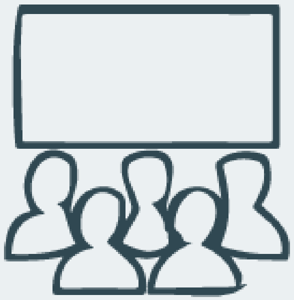
Pay close attention to

- resources your teacher suggests.
- connections to models and science ideas.

Look in the *Key Words Database* for sources to help you identify solutions or relevant physics.

Slide J

Review Teacher Feedback



With your class

Before we develop our own solutions, let’s look through a few examples of finished products.

- What do you notice?
- What is the problem? What is the solution?
- What criteria did the designers of this solution prioritize?

Slide K

Brainstorm Solutions for Our Community

Turn and Talk

What ideas do you have about what we might do as drivers, passengers, and residents that could make driving safer for people in our community by

- raising awareness?
- changing driver behavior?
- making our driving environment safer?

→ Be ready to share your ideas with the class.

Prioritize Criteria

With your group

Step 3, question 4: Consider cause-effect details. Identify criteria and possible trade-offs.

4a. What might be causing this problem? Use evidence from readings to identify **cause-effect relationships** in the system where your problem exists.

4b. **Criteria:** Who or what will you prioritize? What do you want the solution to accomplish?

Trade-offs: Who or what may be negatively impacted by a solution?

Design Solutions

With your group

Step 3, question 5: Consider the criteria you just identified to design possible solutions.

- Work with your team to design 1-2 possible solutions that could meet your chosen criteria.
- Describe or draw the solution you decided on in question 5 of your *Design Challenge Organizer*.

Slide N

Get Quick Feedback from Peers

With a partner

Stand up with your *Design Challenge Organizer*, find a partner not in your project group.

Share your work in question 5 and get **TAG feedback**:

How to give TAG feedback: a) **Tell** something you like.

b) **Ask** a question *about criteria or trade-offs.*

c) **Give** a suggestion. *Which physics models could connect?*

After 1 person shares (1 min), switch roles and repeat.

Share Feedback, Consider Physics Models

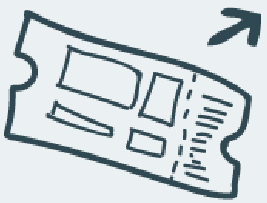
With your group

Share peer feedback:

- What did people like about your solutions?
- What questions came up about criteria or trade-offs?
- What suggestions came up about modeling?

Take notes on at least one copy of the *Design Challenge Organizer*. Notes about physics models belong in question 6.

Design Solutions



Exit Ticket with your group

On *one* copy of question 6, jot down ideas on which physics models could help explain

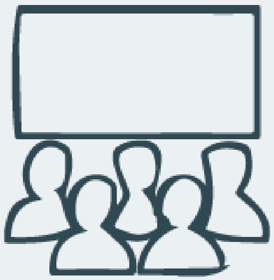
- what makes the problem dangerous or
- how your solution helps make people safer.

Hand in this work for teacher feedback.

Our models include

i. velocity graphs, reaction distance, braking distance.
ii. force and changes in motion while braking, crumpling, or stopping.
iii. conservation of momentum.

Navigate



With your class

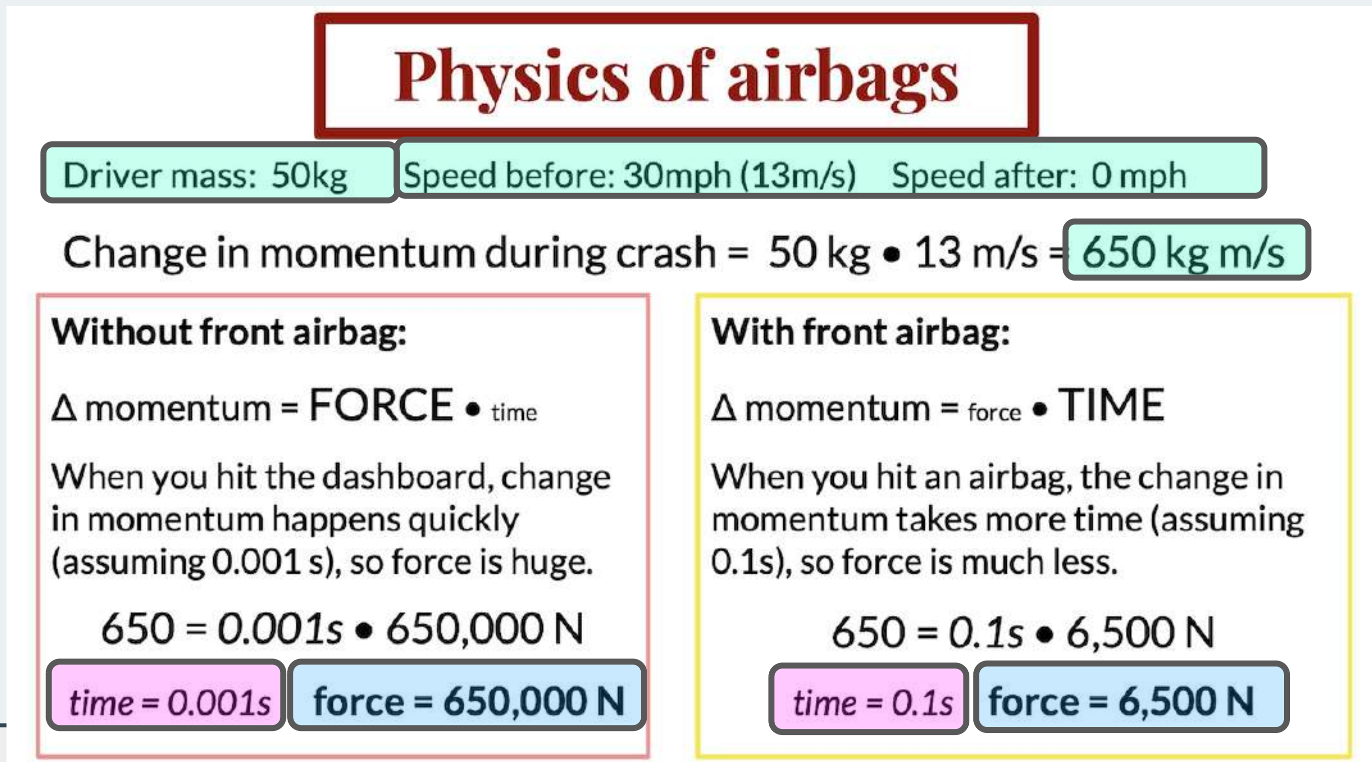
We would like to use physics modeling to help convince others that our work is valid. What if we do not all have specific values we can use in our models?

- How might we come up with valid *assumptions and approximations* for our models?
- How can we tell if an approximated value in our model is *valid or reasonable*?

Consider Reliability of an Example Model

Turn and Talk

Study this example model of a crash with and without an airbag. Which values seem valid or reasonable? Which do not? Why do you think so?



Model Your Problem and/or Solution

With your group

Step 4, question 6: Look back at your answers to question 2 and your notes and feedback in question 6. Discuss how to use mathematical models to help you explain these questions:

- What makes your problem dangerous?

and/or

- How would your solution help make people safer?

Remember the criteria you prioritized in question 4b. If you can, *focus your modeling*

Choose Reasonable Values in Your Modeling

With your group

All models are approximate, but some are more reliable than others. Consider these methods when choosing values. You might

A. model using two different possible values to illustrate a point about safety.

B. compare the value to a similar value you can measure directly with a stopwatch, scale, and so forth.

C. research similar values from a reliable source.

D. make up values that you know are close.

Slide U

Compile Your Best Work into a Final Product

With your group

Step 4, question 7: Choose with your group what you think is the best format (slide deck, poster, pamphlet) for sharing your best work.

Your Final Product will contain these sections:

- A design problem
- One or more solutions
- Prioritized criteria
- Supporting evidence
- Physics models
- Trade-offs
- “How does this plan make people safer?”

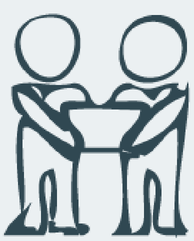
Slide V

Compile Your Best Work into a Final Product

With your group

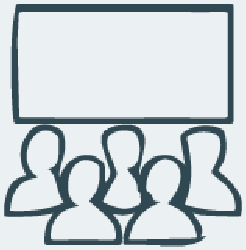
Your Final Product will contain these sections:

- A design problem
- One or more solutions
- Prioritized criteria
- Supporting evidence
- Physics models
- Trade-offs
- "How does this plan make people safer?"



Collaboration As you work, you may assign one team member to trade TAG feedback about a specific section with another student, then report back to apply that feedback.

Look Forward



With your class

Celebrate how far we have come!

Next class, we will have the opportunity to demonstrate in a different context what we have figured out from our project.

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