Why Is Metal Used To Build Race Cars?

Grade Level: K-2
Topic: Properties of Materials
NGSS: PS1.A

Phenomenon

Several NASCAR car parts are made of metal, and the metal frame is inspected by an engineer.

Materials

- Optional: Monster Energy NASCAR Cup Series Video from 4:02:37 to 4:03:15 to reintroduce NASCAR racing to students
- Slide Show: Metal Parts Used in Race Cars
- Video Clip A—NASCAR Automotive Technology Series: Chassis Inspection. Start at 32 seconds and play to 1:53 min. without sound
- Slideshow: NASCAR Roll Cage Investigation
- Roll Cage Investigation Materials
- Each Roll Cage Model
  - 6 pipe cleaners
  - Cotton ball
- Each Testing Ramp
  - Cardboard
  - Books or Box
  - Marker
- Roll Cage Investigation Setup for Teachers
- Student Handout: Roll Cage Investigation Questions
- Materials for Posters or Writing on the Board
  - Poster Paper and Markers or Whiteboard and Dry Erase Markers

Material Management Tips

- Cue the video clips at the appropriate timestamp before class begins.
- Prepare roll cage models, and find materials to create the ramps before the investigation is introduced.
- Consider whether to provide one copy of the Roll Cage Investigation Questions per group or per student. If one is provided per group, students may decide on a recorder of everyone’s ideas to help support students who struggle with reading and writing.
- Prepare poster paper or a place on the board that all students can see with the title “Engineers inspect the metal frame...” to list the ideas that students agree on about why this phenomenon is happening.
### SCIENCE AND ENGINEERING PRACTICE(S)

#### Developing and Using Models

Develop and/or use a model to represent amounts, relationships, relative scales (bigger, smaller), and/or patterns in the designed world.

#### Analyzing and Interpreting Data

- Record information (observations, thoughts, and ideas).
- Use and share pictures, drawings, and/or writings of observations.
- Use observations (firsthand or from media) to describe patterns and/or relationships in designed world(s) to answer scientific questions.

### DISCIPLINARY CORE IDEAS

#### PS1.A Structure and Properties of Matter

- Different kinds of matter exist. Matter can be described and classified by its observable properties.
- Different properties are suited to different purposes.
- A great variety of objects can be built up from a small set of pieces.

### CROSSCUTTING CONCEPTS

#### Structure and Function

The shape and stability of structure of designed objects are related to their function(s).

#### Patterns

Patterns in the human-designed world can be observed, used to describe phenomena, and used as evidence.

### SUPPORTING EQUITABLE PARTICIPATION

#### Interactions

- One-to-one
- One-to-small group
- One-to-many
- Small group-to-many

#### Modalities

How students communicate their ideas

Talk • Text • Visual: Drawing, Symbols, Table, Graph, Chart, and Gesture

### Safety

NSTA encourages K–12 teachers and school leaders to promote and support the use of science activities in science instruction and work to avoid and reduce injury. Additionally, NSTA recommends teachers and school leaders visit the [NSTA Safety Resource](https://www.nsta.org) page for up-to-date information on safety issues and guidelines.
EXPERIENCE PHENOMENON

Students experience the phenomenon or problem. The teacher creates an opportunity for students to connect with this specific event or problem [through prior experience, interests, and curiosities] and raise or identify a student question to investigate.

<table>
<thead>
<tr>
<th>T</th>
<th>What is the teacher doing to support students’ sensemaking?</th>
</tr>
</thead>
<tbody>
<tr>
<td>S</td>
<td>What are students doing to make sense of the phenomenon? [Includes teacher look-fors]</td>
</tr>
</tbody>
</table>

1. Introduce the Phenomenon

Gather students and introduce NASCAR racing to students to elicit excitement and experience the phenomenon together.

Optional: Say, “First, let me remind you of what a NASCAR car race looks like.” Play Monster Energy NASCAR Cup Series video from 4:02:37 to 4:03:15 to reintroduce all students to a NASCAR racing event.

Students watch the video clip to create a shared experience of a NASCAR race.

Inform students that NASCAR race cars are made from many smaller parts, and say, “Today, we will be taking a closer look at one of these parts made of metal, the car’s frame.” Share with students the first slide of the slideshow, Metal Parts Used in Race Cars.

(Slide 2) Introduce the metal frame of the car. Ask, “What do you notice about the metal frame used to make the car?” Allow students to share their noticings and observations first with a partner or small group, then with the whole class.

(Optional) Repeat with metal parts found on slides 3 and 4.

Tell students you also found a video that shows how the metal frame is inspected by a NASCAR engineer and that all NASCAR car frames must be inspected before adding any more parts to the car. Say to students, “While watching the video, try to notice what the engineer is doing.”

Students watch the video and try to notice what the engineer is doing.

Play Video Clip A (Slide 5)- NASCAR Automotive Technology Series: Chassis Inspection

Start at 32 seconds, and play to 1:53 min without sound.
Ask, “What did you notice about the frame of the car or what the engineering was doing?”

Students raise their hands to share ideas about what they think the engineer was doing.

Ask, “What does this video make you wonder about?”

Consider writing down these questions on a poster or board to help navigate to the next part of the lesson.

Allow students to share their questions with a partner or small group. Then have one person from each group share at least one question with the class.

Students share and brainstorm questions with a partner or small group first. One student from each group raises their hand to share at least one of the group’s questions with the class.

Use students’ curiosity related to the metal frame to help navigate to the next part of the lesson by saying, “I have heard several questions about the shape of the metal frame, and I think this might be something we are able to investigate together. Raise your hand if this is something you would like to try to investigate!”

Students raise their hands if they agree that investigating the shape of the frame is the next step in figuring out the phenomenon.

INVESTIGATE

Students engage in the practices of scientists and engineers to build understanding of targeted science ideas (and engineering ideas) needed to explain the phenomenon or solve the problem.

2. Roll Cage Investigation—30 mins

To remind students about the observable properties of metal, ask students, “What did we learn about the observable properties of metal?” Allow students to share their ideas.

Students recall and share the materials: plastic, foam, metal, and rubber.

Then ask, “Why do you think the race car designers used metal to build the frame?” Students ideas should include these:

- Metal can be made into many different shapes.
- Metal is strong and could keep someone safe.
- Metal is hard.

Students share ideas related to the observable properties of metal, including shiny, hard, bendable, and/or strong. Students may use a publicly displayed poster or information on the board from Lesson 1 to help them if provided.
Say, “Let’s take a closer look at the shape or structure of the frame by doing an investigation to try and figure out its purpose or function.” Open the slideshow NASCAR Roll Cage Investigation.

(Slide 2) Share the image of the NASCAR car frame, and reintroduce the concept that a frame is the main supporting structure of the race car.

(Slide 3) Share with students and introduce the center portion of the car frame called the roll cage.

Ask students, “What patterns do you notice in the roll cage?” Consider deepening student understanding of the word patterns by using the following guiding questions:

- What shapes do you see that are repeated?
- What structures do you see that are repeated?

Students raise their hands to share the patterns they can identify. Students may share patterns such as these:

- The metal bars crisscross.
- The roll cage surrounds the driver on all sides.
- There are repeated square shapes.

(Slide 4) Say, “Let’s see if we can figure out why the roll cage is made using these shapes or structures that you have identified. We will do this by using a model.” Remind students that a model is one way that scientists and engineers test their ideas: “A model is a representation or something similar used to help us explain and test ideas.”

Ask students, “What shapes or structures do you notice in the model that are the same as in the roll cage?”

Students share ideas related to the patterns stated above.

(Slide 5) Explain to students that the pipe cleaners are used to represent the metal frame, a driver seat was added to the model, and a cotton ball is used to represent the driver of the car.

(Slide 6) Explain to students that the ramp represents the race track. Review the directions for testing the roll cage by rolling it down a ramp.

(Slide 7) Review the directions for testing two roll cage models at the same time.

Divide the class into small groups of 4 or 5, and distribute a copy of the Roll Cage Investigation Questions to each student or one per group.
Review the directions and questions students will try to answer as a group during the investigation.

Tell students that they will need to come to an agreement on the answers and be prepared to share with the whole group when finished with the investigation.

Send each group to a testing station that contains at least two roll cage models and a ramp.

Allow time for students to complete the investigation. Once students have been testing for several minutes, prompt them to discuss and try to answer the questions as a group by drawing or writing some ideas.

Bring students back together as a whole group and have one person from each group share their ideas for each question one at a time. Use the questions on the slideshow to help facilitate the sharing of ideas. Guide students to recognize the similarities among the ideas shared.

As described in the Teacher Background of the Roll Cage Investigation Setup, the purpose of the facilitated discussion is to help students make sense of the idea that the structure of the roll cage made from strong metal helps provide the function of protecting the driver from getting hurt if the car rolls or hits another car on the track.

**REFLECT**

Students use the new or revised science ideas they developed to help explain how or why the phenomenon occurs and/or to identify solutions to the problem.

**3. Return to Phenomenon**

Say to students, “You did a great job figuring out the function of the roll cage and why engineers use metal to build the frame. Remember that in the video we watched at the beginning of the lesson, we saw an engineer who was inspecting the car frame and taking measurements.”
Return students’ attention to the phenomenon that was shared at the start of the lesson by playing the video clip again, and say to students, “When you watch this video, try to think about why the engineer is looking so closely at the metal frame and taking measurements.”

Play Video Clip A—NASCAR Automotive Technology Series: Chassis Inspection

Start at 32 seconds, and play to 1:53 mins without sound.

Say to students, “Now that we have come to an agreement on why the shape of the frame and roll cage that surrounds the driver with strong metal is used to protect the driver, why do you think that NASCAR engineers inspect every frame of every car before they add on the car body and other parts?”

Allow students to share their ideas with a partner, then have a few share with the whole group.

Create a poster, or write on the board in a place all students can see the idea all students agree on using a thumbs-up or thumbs-down signal. Help guide students to agree on the ideas related to engineers inspecting the metal frame to make sure the frame is built well, the metal is thick enough, and the drivers are safe.

Say to students, “Now that we know that metal is used to build strong frames, where else do you think we can find metal frames that keep people safe?” Encourage students to try to find other examples in their lives, on the playground, or in their neighborhoods of metal being used to build a strong frame.

Students watch the video for the second time and try to figure out why the engineer is looking so closely at the metal frame and taking measurements.

Students share their ideas first with a partner, then raise their hand to share their ideas with the whole class.

Students give a thumbs-up signal when they agree with the idea that is shared and a thumbs-down signal if they disagree.

Students share examples of other places metal is used to build strong frames. Some examples may include these:

- Posts for fences
- Metal frames on buildings
- Metal posts on the swing set
- Metal frames on other types of vehicles
- Metal frames on scaffolding

Draw a line under the agreed-upon student ideas on the poster or on a new area of the board to list “More examples of metal frames” that are shared by students.
AT THE RACE TRACK

Find examples of metal being used as a strong frame to keep people safe.

• Can you find evidence of a metal frame being used to build the seating area?
• Can you find evidence of a metal frame being used for barriers or fencing?
• Can you find evidence of a metal frame being used in the race cars?
• Where else can you find evidence of metal frames being used to support structures? Make a list of all the places you can identify metal frames being used to support structures and to help keep people safe.

This lesson could be one in a series of lessons building toward the following:

2-PS1-2. Analyze data obtained from testing different materials to determine which materials have the properties that are best suited for an intended purpose.*

[Clarification Statement: Examples of properties could include strength, flexibility, hardness, texture, and absorbency.] [Assessment Boundary: Assessment of quantitative measurements is limited to length.] * The performance expectations marked with an asterisk integrate traditional science content with engineering through a Practice or Disciplinary Core Idea.

2-PS1-3. Make observations to construct an evidence-based account of how an object made of a small set of pieces can be disassembled and made into a new object.

[Clarification Statement: Examples of pieces could include blocks, building bricks, or other assorted small objects.]