Motorsport Science 201 (SBSA)

This module is designed for SBSA Scouts to explore the fun, excitement and scientific principles and practices applied to motorsport racing and how race cars and drivers perform, in a safe manner.

1) **Exploration**

   Watch and/or research (read) or a combination of both for three hours on the topic of motorsport racing.

   Watching can include a show/documentary/video or live performance (including attending a race – like a pinewood derby and making notes of what you saw). Research (reading) can include articles, books or magazines. The shows or research should involve *details about* motorcraft racing (automobile, motorcycle, power boating or aircraft).

   Then do the following:

   a) Make a list of the programs / sources you used (to show to your counselor).
   b) Create at least 5 questions or ideas from what you watched and learned.
   c) Discuss three of the questions or ideas with your counselor that relate to racing science. What did you find most interesting?

2) **Merit Badge**

   Complete and earn a merit badge from the following list or complete one optional activity. The merit badge must be one that you have not already counted toward another Nova award but can be one that you previously earned. If there is a Test Lab Merit badge you feel is appropriate, talk with your Nova Counselor for their review and permission.

Automotive Maintenance	Traffic Safety

Optional activities. If you have already used the above merit badges for a previous Nova award, complete one of the following optional activities. After completing the option talk with your Nova Counselor about what you learned.

Option 1: Volunteer at a Pinewood Derby and learn how the racetrack and electronics work to provide race results.

Option 2: Complete a virtual racing simulation of at least 60 minutes. There are numerous free PC simulators such as Trackmania, for its track creation and competitive time trials, Disney Speedstorm for its casual, kart-style racing, and Formula Evolution 2024, a more realistic multiplayer simulation game. As you are racing, think about the strategy and safety aspects of a successful race.

Discuss with your counselor how the Merit Badge or optional activity relates to motorsport science.

3) **Safety and Design**

Complete all activities below, then talk with your Counselor and share what you learned and how it relates to modern racing.

a) Learn about the safety equipment and essentials/personal protective equipment for motorsport racing. Discuss a few of these items with your Counselor.
b) Identify the types of motorsport racing. How are the cars different and/or similar? What are the differences in the race "tracks" for the different types of racing? Are there different aspects of science or engineering that apply to the different racing styles?
c) There is a great deal of science (engineering, physics, material science) used in racing. Investigate the design of race cars and racetracks, and how the design affects race performance and racing safety.
d) A race driver and their team can be thought of as research scientists who are constantly applying the scientific method to learn more about racing, their equipment and how to come up with a winning strategy. Pretend you are a part

of a race team (driver, pit crew, engineer). Identify three items you could "research" to improve your race performance (think about aspects of the race cars or driving strategies). Review the scientific method and apply it to your race research (for example, how does tire design affect performance of the race car?). Tell your counselor how you would test these "research" items.

4) Visit / Meet and Experiment

Complete a, b, and c.

a) Attend a motor race in person (or if that is not possible watch one on TV). Look at the crowds watching the race and listen to the announcers. What are they talking about? What science principles do you notice about the cars and pit crews? Discuss with your counselor the science that you noticed at this event.

b) Talk to someone involved in racing. This could be a driver or a pit crew member. If this is not possible talk to an automotive mechanic that works on "regular" cars. Ask them about the science involved in racing or driving. Discuss with your counselor the STEM that is being used by those you spoke with and how it relates to racing or driving.

c) Perform a racing study with Hot Wheels™, Matchbox cars™, Pinewood Derby cars or similar vehicles, focusing on the race car design and how it affects its race performance. Set up the appropriate track with an incline for the cars you choose. If using Hot Wheels™ and or Matchbox cars™, a Hot Wheels track will help provide meaningful results. If using Pinewood Derby cars an appropriate Pinewood Derby inclined track should be used. There are numerous car design factors that may affect performance. Pick a minimum of three cars that are similar in length and have similar wheels but vary significantly in weight (use a scale to weigh the cars). Place the cars at the same starting point on the track, mark a "finish line" on the track and let the car go down the track simultaneously. Use a stopwatch to time the cars travel to the finish mark.

   1) Is there a correlation (relationship) between the car weight and the race time?
   2) What car design features could affect the race time other than weight?
   3) Using a protractor, you can get a rough measure of the angle of the racetrack

and length of the angle before the track becomes flat. What would changing the angle do to the race time? If the racetrack was longer after the incline how would the race time change?

Make these changes and rerun the experiment to determine how it affects the study results.

4) There are many other variables that could be tested. What if there was an open “jump” in the track? How would the weight of the car, length of the open jump, height of the starting point contributes to a successful jump? What if there was a banked turn after the incline track? What car characteristics would ensure the car stays on the bank and doesn’t come off the track?

Discuss with your counselor what you learned from this experiment and how it applies to everyday driving.

5) Discuss

Reflect on what you have done in this Nova, and discuss with your counselor how the ideas, activities, and/or principles involved in this topic impact your everyday life, i.e.: how does motorsport racing make cars and driving safer and better for everyone.

Counselor Notes

- This Nova is applicable to SBSA Scouts.
- It may be helpful for Scouts to work with an adult on these activities.
- Many of these activities involve accessing the internet. Please make sure Scouts follow safe internet practices (parent permission).
- There are several links to reference materials. These will need to be checked periodically to make sure they have not changed.
- A Scout can do more than the required activities, but they cannot be required to do more to earn the recognition patch.
- There are numerous opportunities for some of these activities to be turned into awesome Unit or Camporee activities for a fun STEM experience.

Specific notes

- **Racing Safety**

  A few of the basic safety items for racing include:

  Racing Helmet, Fire suit, Safety Harness, HANS Device, Window Nets and Gloves and boots

- **Racing Science aspects**
  - Dynamics and Forces (gravity, friction, and aerodynamic drag)
  - Aerodynamics (Design of race cars)
  - Tire Technology
  - Track Design
  - Driver Physiology and Psychology
  - Data Acquisition
  - Crash Safety
  - Human Performance

- **Visit and Meet Examples:**

  In addition to various motor races that can be found locally or on television, additional options include Pinewood derby competitions, Soap box derby and Collegiate design teams that build and compete in various competitions.

- **Examples of Scientific Principles in Racing:**
  - Newton's Laws of Motion
  - Bernoulli's Principle
  - Friction
  - Kinetic Energy

- **Resources for Learning More:**

There are many resources that can be found by searching the internet. Here are just a few:

  - The Science of Motorsport book by David P. Ferguson
  - The Physics of NASCAR: The Science Behind the Speed by Leslie-Pelecky Diandra
  - Physics World article "NASCAR: the science of racing safely"
  - YouTube channels with videos about the physics of racing and Formula 1 engineering
  - NASCAR kids website
  - YouTube videos on racing for CS including Cars (Disney)

- **Virtual racing simulation:**

  There are numerous free PC simulators such as Trackmania, for its track creation and competitive time trials, Disney Speedstorm for its casual, kart-style racing, and Formula Evolution 2024, a more realistic multiplayer simulation game. As you are racing, think about the strategy and safety aspects of a successful race.