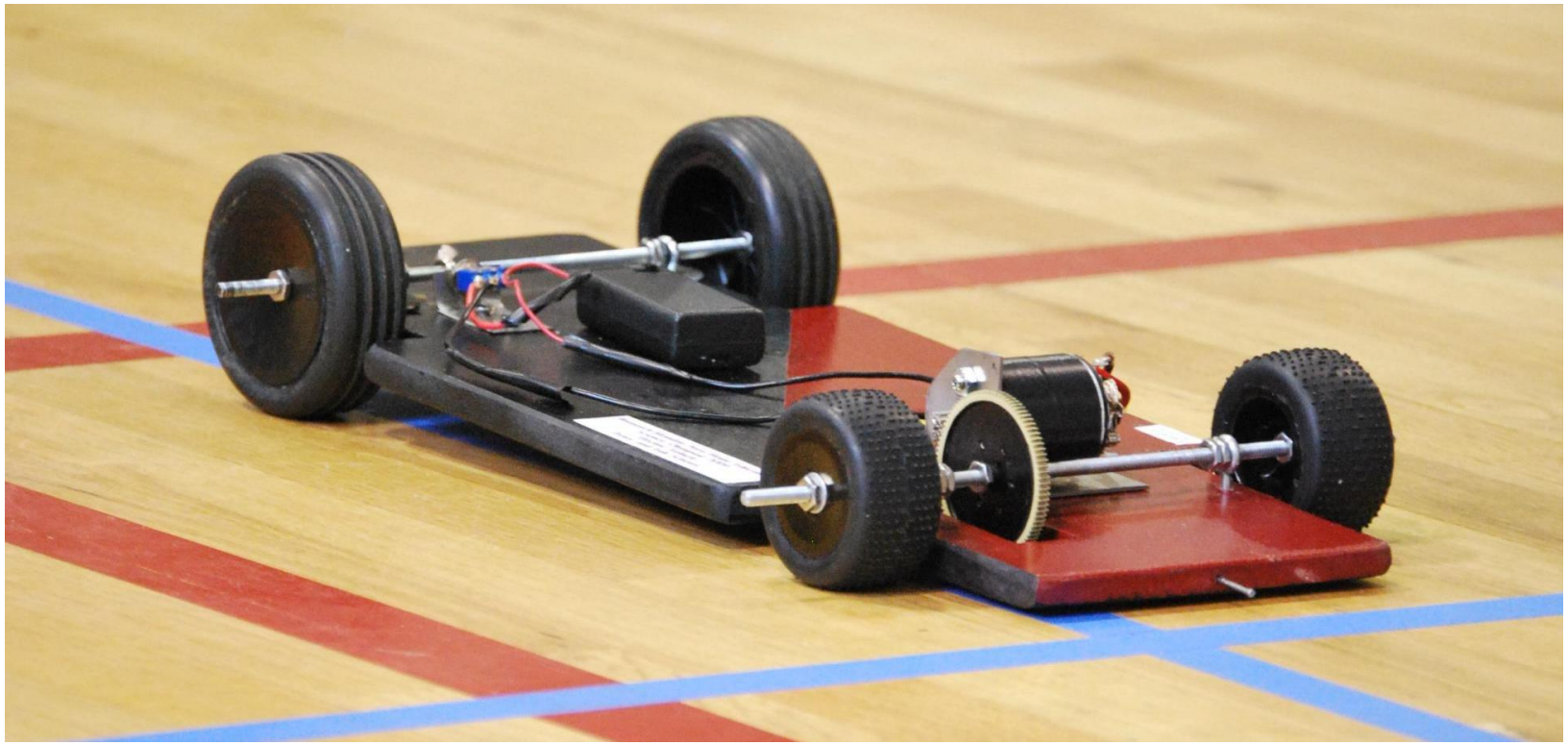
Battery Buggy

Division B

http://api-static.ctlglobalsolutions.com/science/SO_B_2018FINAL.pdf

Objective:

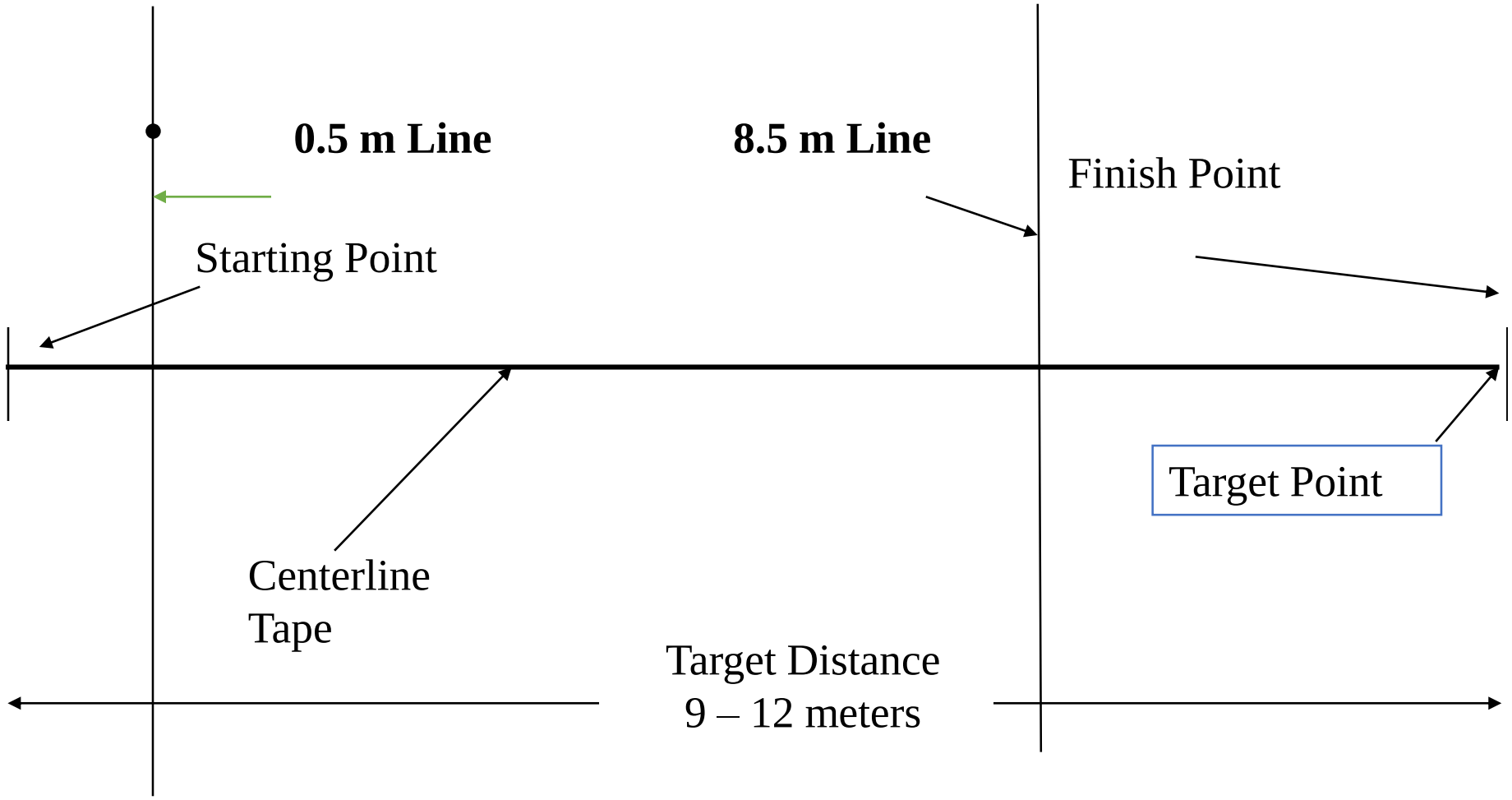
To build a battery powered vehicle travels a specific distance as quickly as possible and stop as close as possible to the center of the finish line.



New this year

- **Practice Log** - Teams must record at least 10 practice runs with at least 3 parameters, **which** must include distance, time, and any additional parameter (i.e. wheel turns for braking, distance from Target**). Logs will be impounded.**
- **Review data -** The supervisor will review with teams the data and penalties recorded on the scoresheet.

The Track


0.5 m Line
8.5 m Line
Finish Point
Starting Point
Target Point
Centerline
Tape
Target Distance
9 – 12 meters

The Competition

- must place their buggy's Measurement Point on the Starting Point
- will set the buggy in motion by actuating some sort of electrical switch. They may not touch it, but must use a #2 unsharpened pencil supplied by ES
- may use non-electronic measuring devices to verify the track dimensions (but they cannot use the vehicle to do so)
- may place a target, which must be removed prior to starting each run, on the finish line to aid in aligning the buggy
- MAY, between runs, remove/install/change any impounded parts, including batteries.
  - May not use AC power outlet during 8 min.
- will be allowed 8 minutes to adjust their buggy and make up to 2 runs – if the a run is started before the 8 minutes is up, that run may be completed
- Must wait behind the start line during the runs until called by the Event Supervisor

Scoring - Points

The **Run Score is equal to the sum of the following. Remember that LOW SCORE wins.**

- The **Distance Score** – This is the Measured Distance in cm to the nearest 0.1 cm x4
- The **Time Score** – is the Run Time x2
- The **Center Line Bonus** – If the center line tape remains between the left and right outside edges of the vehicle's widest wheelbase during the run between the Start Point and the Target Point, 25 points will be deducted. Bonus awarded even if vehicle veers off center tape after the widest wheelbase of the vehicle passes the Target Point.
- Run Score = Distance Score + Time Score + Center Line Score
- **The Final Score will be the lower score of the 2 Run Scores**.
- Ties in a scored run will be broken by….
  - 1st: Lower Distance Score
  - 2nd: Lower Time Score
  - 3rd: Lower Score of the other run

Batty Buggy Systems Construction/Suggestions/Ideas

Possible ways to approach the event - May be consolidated or divided as necessary.

First issue – Kinetic Energy

Do whatever you can to increase the speed of the buggy!

- Mass
- Wheels – 3 vs. 4
- Motor “strength”/torque/RPM
- Efficiency of energy transfer
- Reduce friction of the buggy components
- Battery decision – what will give you the greater voltage and therefore the faster motor.
- Anything else you can think of!!??

Body / Chassis

- Connects all of the other parts/systems together
- Is probably the easiest to design and build
- “A matchbox car CANNOT travel a straight line for a great distance.”
  - Therefore, make both the wheelbase AND the track as wide as the rules allow!
  - Be careful, “No 2 rulers are alike!”
- Strongly consider some way to adjust the steering of your vehicle – “It is difficult to get the 2 axis parallel to each other.”

Wheels and axles

- Axles may be part of the transmission or a separate system
- Wheels are VERY difficult to make exactly round → SO DON'T MAKE THEM!
- Large diameter Wheel
  - Revolves fewer times to travel a given distance.
  - Transmission must have a higher gear ratio.
  - Vehicle might travel faster
  - Heavier
- Small diameter wheel
  - Revolves more times to travel a given distance
  - Transmission can have lower gear ratio
  - Vehicle might travel slower
  - Lighter
- Optimum size is somewhere in between
  - Affected by motor power
  - Affected by transmission gear ratio
- **Recommendation: Wide wheels tend not to drift as much and, IMO, tend to force the vehicle to go straighter!...but have greater mass.**

Motor

- May be part of electrical system or transmission
- Must be close to total battery voltage
  - Will operate within a wide voltage range - +/- 50% of rated voltage typical (but +/- 10% better for the motor)
- RPM (speed) varies with load and battery voltage
- Torque (power) varies with battery voltage
- Few types available at reasonable cost

Transmission

- Most difficult to design / build
- Reduces high RPM of motor to low speed for driving wheels
- Several types possible
  - Direct Drive
  - Reduction Gear
  - Worm Gear
  - Planetary Gear
  - Belt / Pulley Drive (AVOID!)
- Expensive to buy
- Definitely a candidate for surplus / salvage

Electrical System

Batteries

- Voltage should be suitable for motor
- Larger batteries last longer / weigh more
- Evaluate different types
- Holder can be part of chassis or separate component

Motor

- Terminals are almost always identified in some way. e.g. + , square, notch
- If motor turns the wrong direction, reverse the wires connected to its terminals

Start Switch

- Should be easy to operate
- Should be in an accessible location
- Can be “Home Made”

A great switch to

use to start the buggy.

A micro switch to open the circuit at the end of the run.

Steering Mechanism

- Adjusts buggy to travel in a straight path.
- Adjustment need not be very large
- Should retain setting reliably

Distance measuring device

- Measures how far the buggy has traveled
- Turns off motor
- May apply brake

Stop Switch

- Actuated by the distance measuring device
- May be the same as the Start switch
- Turns off motor to stop buggy
- Could be used to apply brake

Wires

- Almost any type of wire can be used
- Don’t use too large a size
- Stranded wire will flex more before breaking
- Solid wire holds its shape better
- For better reliability solder all connections

Brakes

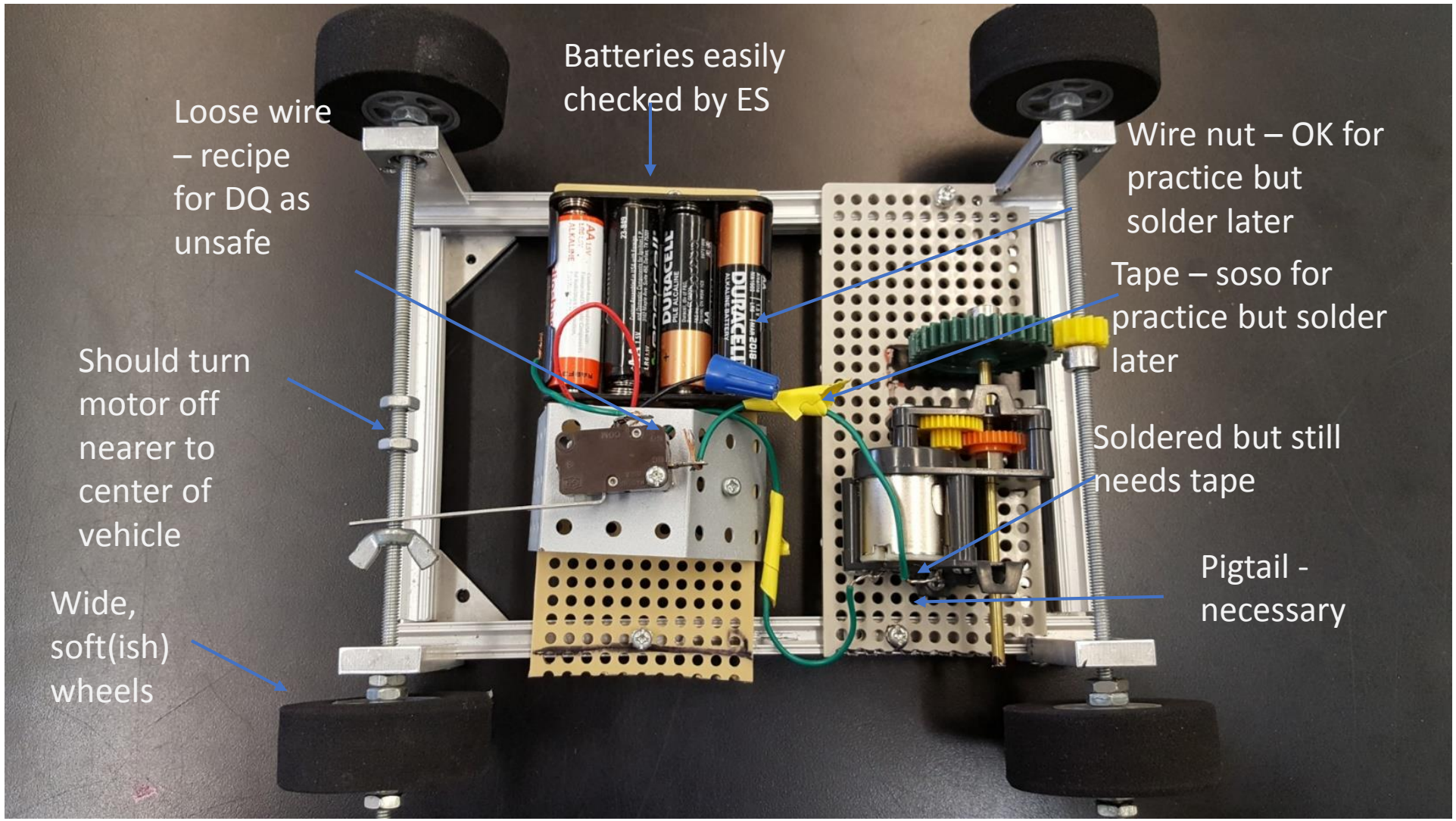
All methods must involve either disconnecting the transmission or stopping/turning off the drive motor!

- None – Coast to a stop – Called the “Prayer” method of braking!!
  - Easy to implement
  - Distance unreliable
- Mechanical Types (tend to be easier to make)
  - String and Axle
  - Wheel Jam
  - Wing nut and Axle (by far the most popular)
    - **Best combination: Have the wing nut not only lock the wheels but simultaneously turn off the motor with a mini lever disconnect switch.**
    - **http://www.youtube.com/watch?v=RJwFtkFSuJM**
- Electrical Type
  - Use the drive motor as the brake – works best in direct drive transmission
  - A DC motor provides some dynamic braking when its terminals are shorted together.

Final Suggestions

- Think LIGHT LIGHT LIGHT
- Design and build early!
- Calibrate, calibrate, calibrate
- Be as consistent as possible
- Practice at many different track lengths
- Keep a record of data
- Try different batteries, motors
- Did I say calibrate?
- MAKE sure that it goes straight – those -25 points could make a big difference
  - Use alignment tools to help here
- Will you use two different sets of batteries for the two runs?

THE END!


Batteries easily checked by ES
Loose wire – recipe for DQ as unsafe
Wire nut – OK for practice but solder later
Tape – soso for practice but solder later
Should turn motor off nearer to center of vehicle
Soldered but still needs tape
Pigtail - necessary
Wide, soft(ish) wheels

How should I prepare my team?

- Read the rules
  - When you are done, read them again!
- Build it now!
  - Don’t wait, you may go through multiple iterations
  - Don’t skimp on “critical” materials
- Know how to score and track your vehicle’s performance
  - Score each practice run using the scoring formula

Questions?