Electric Cars

What my friends think I drive

What my mum thinks I drive

What society thinks I drive

What my husband thinks I drive

What I think I drive

What I actually drive

Electric Vehicle ’17
(Draft but updated 8/17/16)

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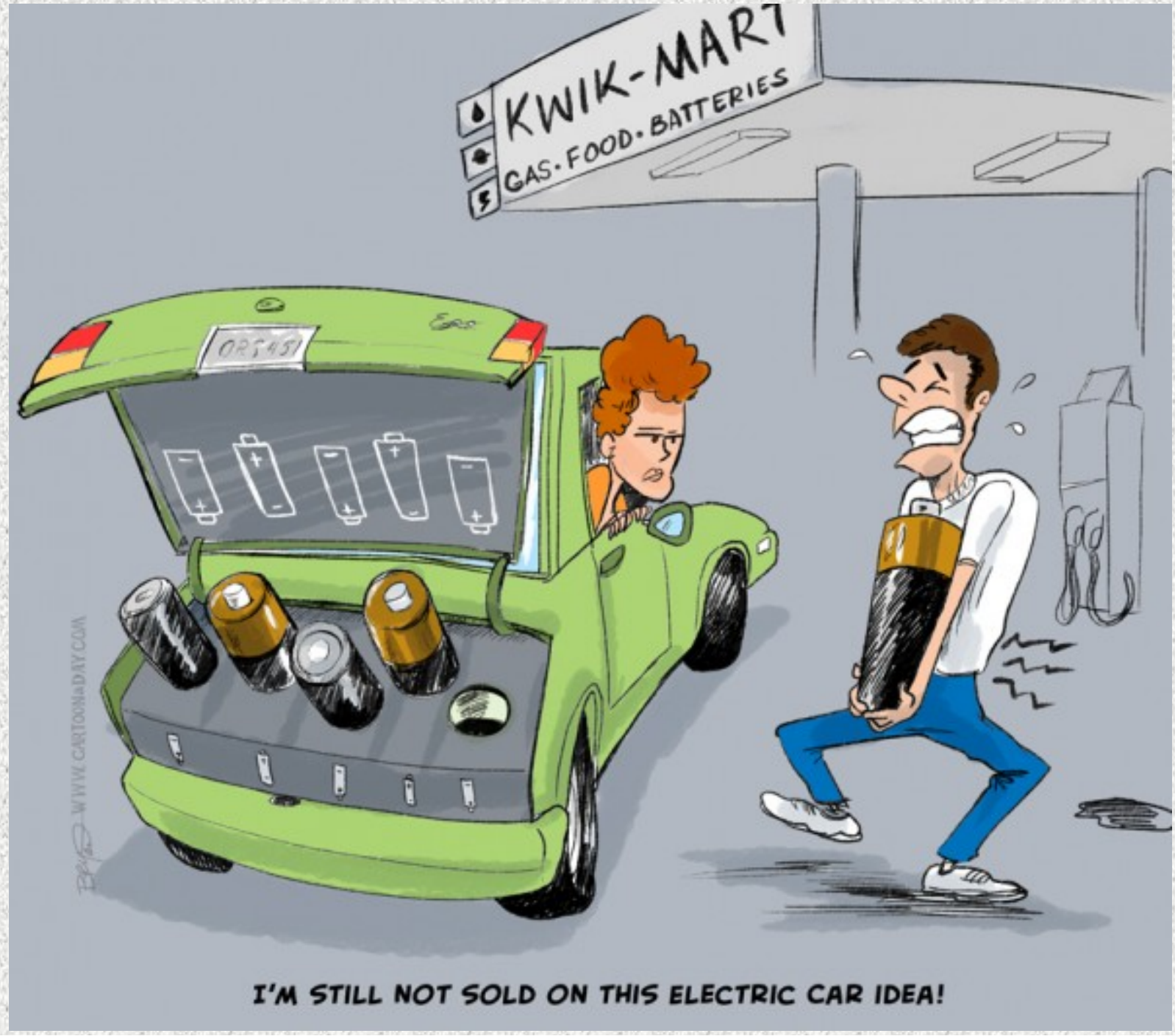
Object:

A battery-powered vehicle travels down a track as quickly as possible and stops as close as possible to a target point.

Just like some of these from YouTube

Construction

- Designed to travel 9.00 to 12.00 m
  - Distance posted after impound time elapses
- Voltage MUST be ≤ 9 V between any two points as calculated from manufacturer labels.
  - Commercially available batteries with voltage on labels
  - Lead acid batteries not allowed
  - ES MUST be able to easily read the voltage on the batteries
- ALL energy for propulsion must be electric and come from these batteries.


KWIK-MART
GAS · FOOD · BATTERIES
I'M STILL NOT SOLD ON THIS ELECTRIC CAR IDEA!

Construction cont'd

- Additional non-electric energy storage devices may be used for other functions but may not be used to propel the vehicle.
- Components (e.g., motors, gearboxes, motor controls, bodies, and chassis) may be purchased or made by competitors.
- Electronic components (i.e., solid-state devices such as transistors, integrated circuits, diodes, and microprocessors) are allowed.

More Construction

- All parts of the wheels or treads in the vehicle's ready-to-run configuration must fit in a 30.0 cm x 60.0 cm space.
- No height restriction.

Scoring dowel

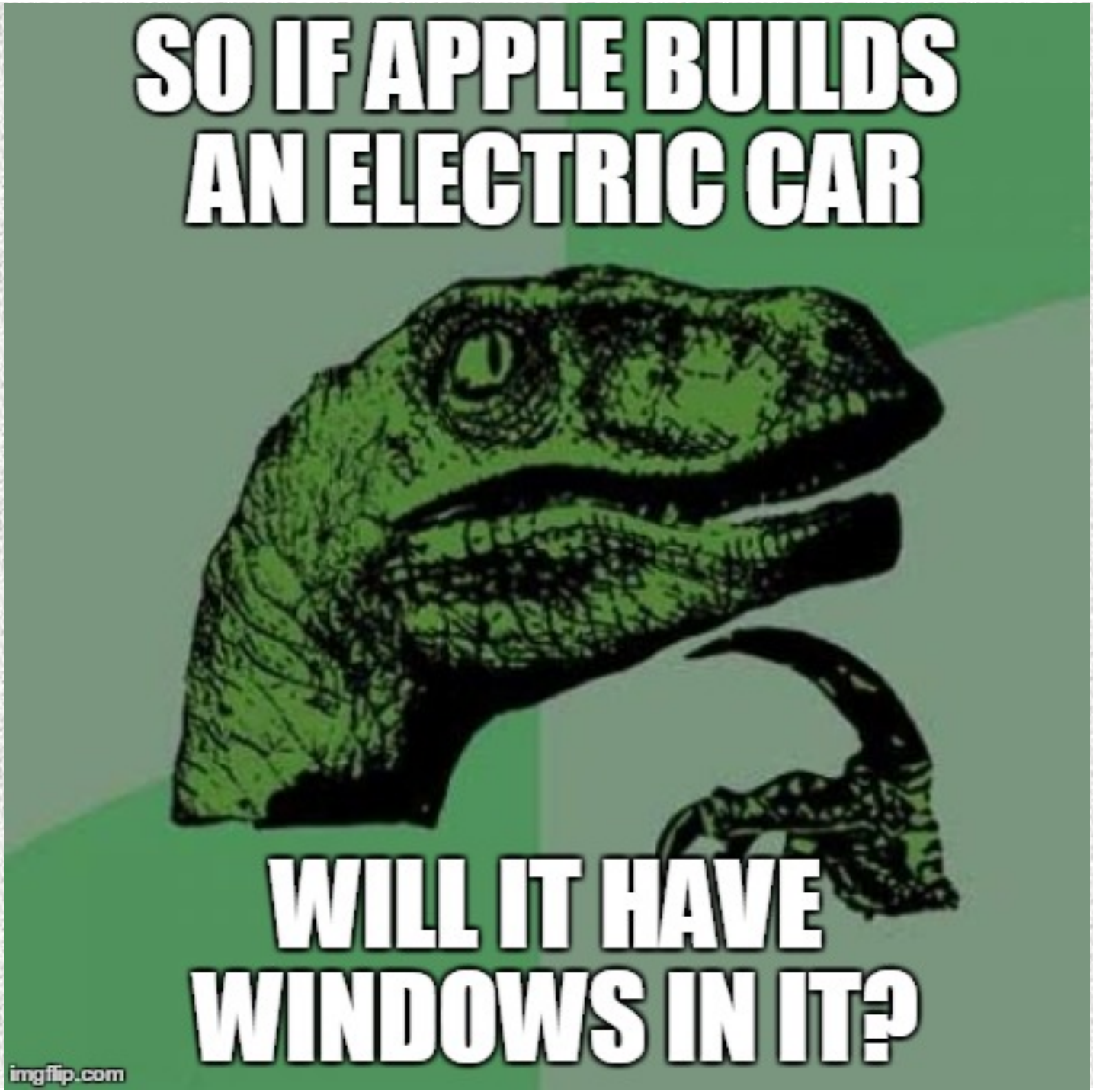
‡ **Single** ¼" wooden dowel* must be attached to front end of vehicle.

- Approximately perpendicular to the floor
- Leading part of vehicle at all times
  - Extend ≥ 20.0 cm from the floor
  - Photogate must be approximately 17.0 ± 2.0 cm above floor
  - Must be ≤ 1.0 cm of the track surface
    - *The cause of many penalties!!!*
  - No part of vehicle may extend in front of the dowel during its entire run (with the exception of the dowel attachment which may ≤ 2.0 cm).
- The dowel's front bottom edge will be the vehicle's Measurement Point for distance measurements.

Construction

‡ Vehicle must be able to be started by actuating a button or switch using any part of an unsharpened #2 pencil with an unused eraser.

- Action must be perpendicular (vertical) to the floor
- A non-vertical actuation is a construction violation


SO IF APPLE BUILDS AN ELECTRIC CAR
WILL IT HAVE WINDOWS IN IT?
imgflip.com

Still more construction

- Sighting, aligning, and guiding devices are allowed but must be removed before the run. Labeled lasers may be used but they must follow the official SO guideline for lasers found on the SO website
- The only parts of the vehicle allowed to contact the floor are the wheels/tread in contact with the floor in ready-to-run position.
- Pieces falling off are a construction violation.

Finally, construction – The End

- Vehicle must not be remotely controlled or tethered.
- Stopping mechanism must work automatically.
- **NEW: Sec.4: Practice Log – at least 10 practice runs with 3 parameters. Must be impounded.**
- Competitors must be able to answer questions regarding the design, construction, and operation of the device per the Building Policy found on www.sonic.org.

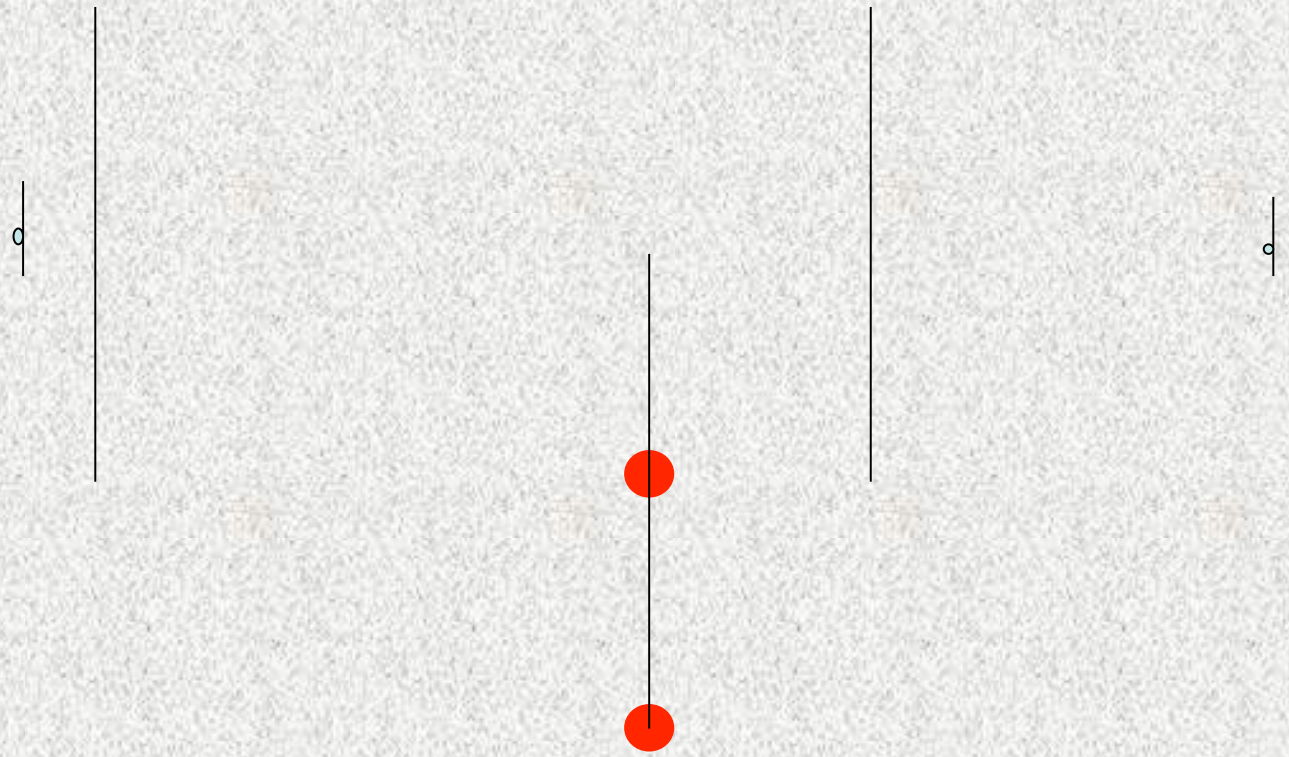
THE ALL NEW ELECTRIC CAR
IT'S IDEAL FOR THE MAN WHO WORKS CLOSE TO HOME
764

The Track

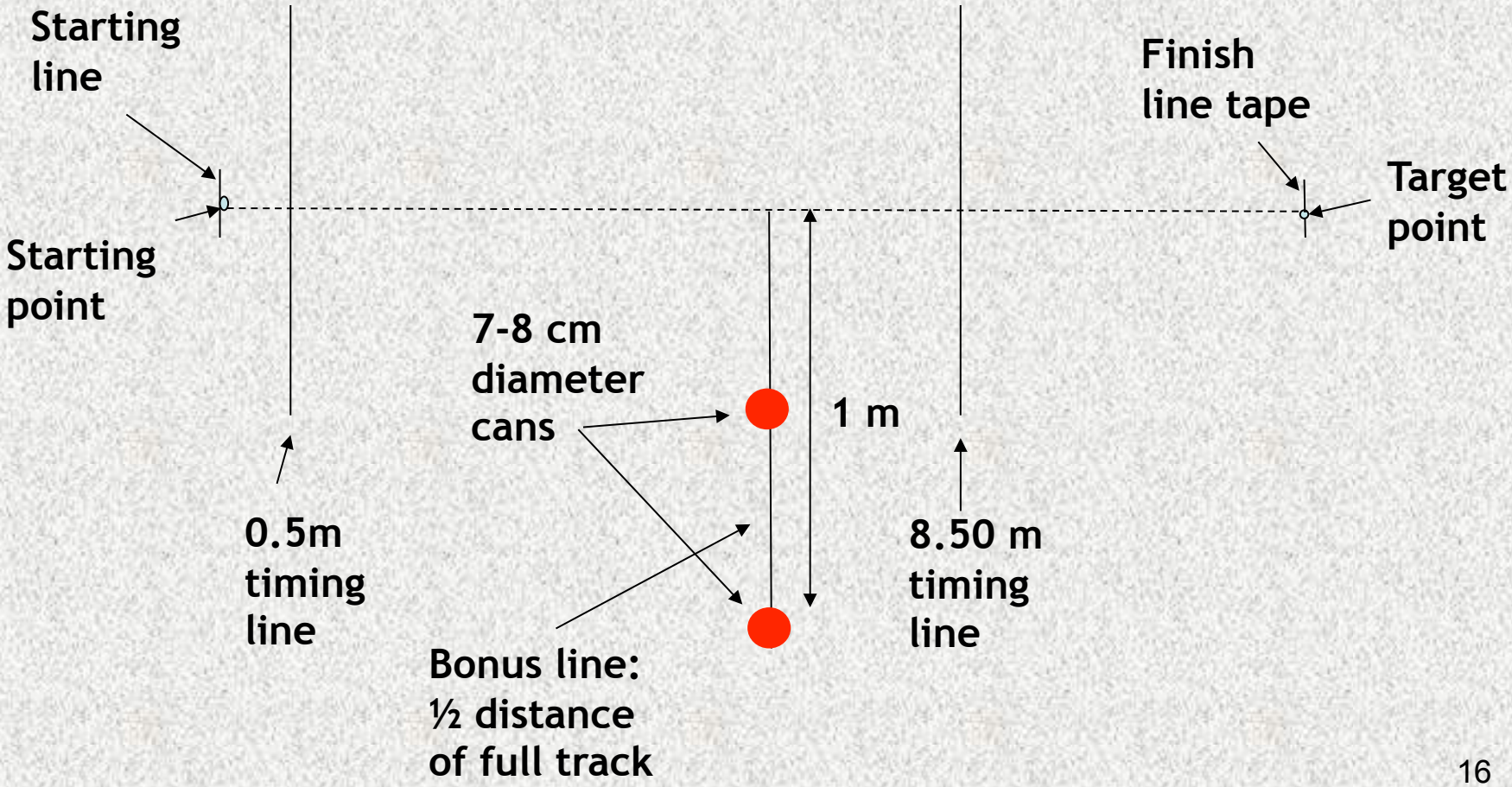
The track will:

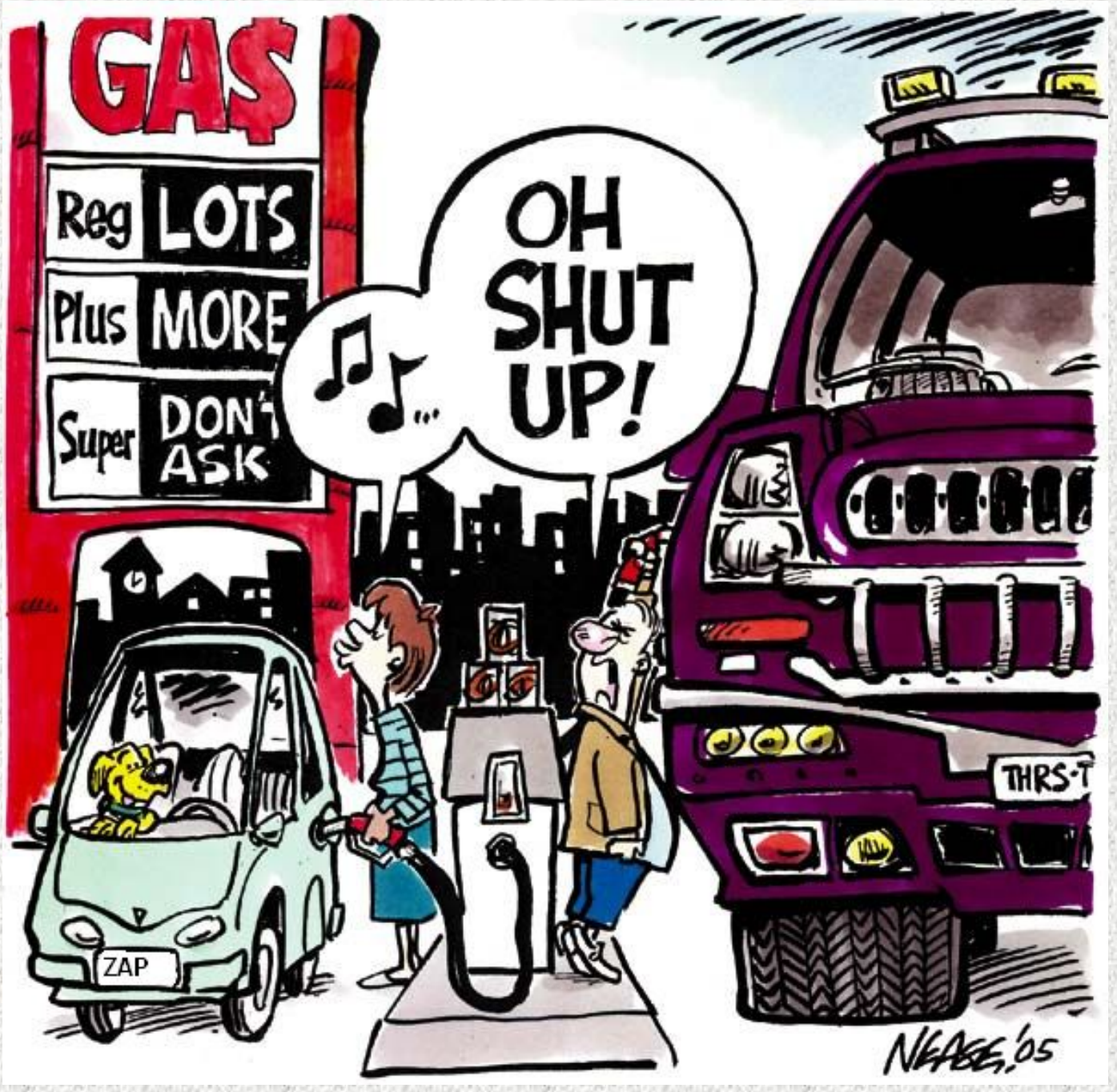
- be on a smooth, level, and hard surface
- have Starting Line, Target Line, and lines for the bonus and timing marked with approximately 2.5 cm (~1”) tape on the floor.
  - A Starting Point and Target point at the center of the respective lines must be clearly marked
- have “free space” to allow the vehicle to stray from the center and past the finish line
- If more than 1 track is used, contestants may choose which track to use. Both runs for a team will be on the same track.

The Track



The Track


Starting line
Starting point
Finish line tape
Target point
7-8 cm diameter cans
1 m
0.5m timing line
8.50 m timing line
Bonus line: ½ distance of full track


GA$
Reg LOTS
Plus MORE
Super DON'T ASK
OH SHUT UP!
ZAP
THRS-T
NEAGE, '05

Competition

During the competition the students:

- Must impound the vehicle, batteries, practice log and spare parts during the assigned impound time
  - between runs, competitors MAY remove/install/change any impounded parts, including batteries.
  - Tools, data, and calculating devices need not be impounded
- will be allowed 8 minutes to adjust their vehicle and make up to 2 runs - if the vehicle is in the ready-to-run configuration before the 8 minutes is up, that run may be completed
- may place a target, which must be removed prior to starting each run, on the finish line to aid in aligning the vehicle
- MUST place their vehicle's Measurement Point over the Start Point at the start of their run.
- will set the vehicle in motion by actuating some sort of electrical switch
- Competitors and supervisors are the only ones allowed in the track area
- Must not leave the area or receive outside assistance, materials, or communication

Competition

‡ The teams may:

- Adjust their vehicle before each run
  - Using only impounded parts
  - While in the start area
  - Within their 8 minutes
    - Providing the vehicle continues to meet specifications
- Move the Inner Bonus can or ask to have the cans removed.
  - Their responsibility to make sure the distance between the two cans is measured by the ES.
- May use their own measuring devices to verify track dimensions
  - During their 8 minutes
  - May not roll the vehicle on or adjacent to the track surfaces between the start and finish line at any time prior to or during the competition.
- Not use any substance which may damage the floor

YOUR $100,000 ELECTRIC CAR BROKE DOWN
COULD'VE HAD A V8
quickmeme.com

Competition

- **The teams may also:**
  - **Use sighting, aiming, and guiding devices placed on the track**
    - **Must be removed before the run begins**
  - **Use aligning and sighting devices mounted on the vehicle**
    - **Need not be removed**
    - **there is no prohibition on electric or electronic devices. So a laser could be used to align the vehicle. See Laser Policy on soinc.org**

And more Competition

- The vehicle must remain in its ready-to-run configuration without being touched.
- Competitors may not use AC outlet power during their 8 minutes.
- If the vehicle does not move upon actuation
  - It does not count as a run
  - Team may request to set up again for this run
    - But will not get additional time
- The team may not follow the vehicle down the track
  - Must wait until called by Event Supervisor

Timing

- Time starts when the vehicle crosses the 0.50 m line and ends when the vehicle crosses the 8.50 m line
- 8 minute event time
  - Stops when the vehicle stops for measurement
  - Begins again when competitors pick up the vehicle
  - May not roll the vehicle on the floor during measuring
- If the vehicle passes the 0.50 line but not the 8.50 m line
  - Time recorded and distance measurement taken.
  - Competition violation (1000 pt. penalty)

Failed Runs

- Vehicle travels in the wrong direction
- Second run does not occur in the 8 minutes
- If the time or distance cannot be measured
  - Starts before the Event Supervisor is ready
  - Moves but does not go at least 0.50 m
  - Competitors pick up the vehicle before it is measured.
- Teams filing an appeal must leave all impounded material with the Event Supervisor

DEAR GOOGLE

THIS

NOT THIS

Scoring

- LOW Score wins
- Distance Score
  - Point-to-point measurement vehicle's Measurement Point to the Target Point to the nearest 0.1 cm.
  - Vehicle can stop on either side of the Target Line
- Bonus = 0.2 x (110-Distance between cans (0.1cm))
- Run Score = Run Time (s) + Distance Score (cm) - Bonus (cm) + Penalties
  - Negative scores are possible.
- Final Score = Better of the 2 Run Scores

Scoring

- **Penalties**
- Incomplete Practice Log: 250 pts.
- No Practice Log: 500 pts.
- Each letter under Competition that is violated will incur 1000 pts penalty per occurrence for that run (max. of 4000 pts)
- A run with any violations under Construction will incur a 5000 pt penalty for that run (max. of 15000 pts)
- Device not impounded during impound period must incur a 10000 pt penalty for each run

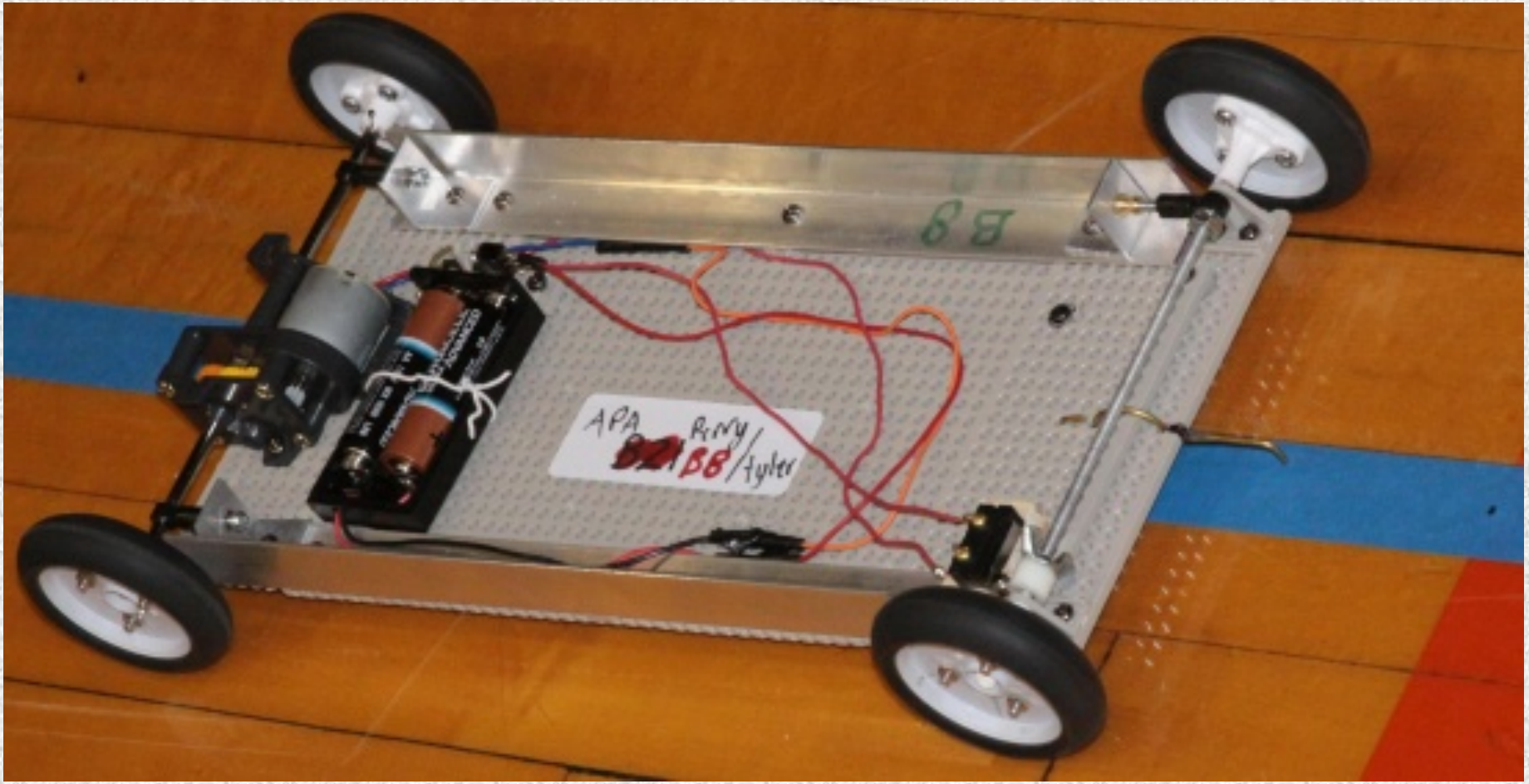
Scoring

- Ties will be broken by:
  - 1. lower non-used Run Score
  - 2. lower Run time of the better run
  - 3. lower Distance Score of the better run
- Participation points given to:
  - Teams who cannot complete a run within the 8 minutes
  - Teams who have 2 Failed Runs

Scoring Example

- First Run
  - Distance Measurement was 67.6 cm from Finish Point
  - Run Time of 4.3859 seconds
  - Distance between cans was 45.8 cm and vehicle passed through successfully
  - No penalties (complete practice log, no construction or competition violations)
  - **Run #1 Score = 4.38529 + 67.6 - (.2 x (110 - 45.8)) + 0 = 59.14529**
- Second Run
  - Distance Measurement was 21.3 cm from Finish Point
  - Run Time of 5.09 seconds
  - Can distance was 39.7 cm
  - Competition Penalty of 1000 points
  - **Run #2 Score = 5.09 + 21.3 - (.2 x (110 - 39.7)) + 1000 = 1012.33**

Final Score = 59.14529


APA
Perry
BB
Tyler

Electric Vehicle Systems Construction/Suggestions/Ideas

Possible ways to approach the event.

First – A BIG decision

ELECTRONIC OR NOT?

- Pros and cons
- What are the capabilities of your students?
- Accuracy vs. Easiness?
- Do you want this to be an entry level event?
- Cost concerns!
- What science do you want your students to learn? Mechanics, basic electricity, programming, robotics?
- Consistency

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!**

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”

Steering Mechanism

‡ If attempting the bonus, vehicle should have an adjustable and calibrated steering mechanism.

‡ Adjustment need not be very large

‡ Should retain setting reliably

Distance measuring device

‡ Measures how far the vehicle 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 vehicle
- Could be used to apply brake
- YouTube Battery vehicle Stop Switch

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!

Brakes (cont.)

- 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.**
- 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.

Brakes (cont.) And Electronic ideas

If you decide to go electronic, then here are some ideas that have been used in the past:

- HOME MADE: Circuit boards, IC's, some easy, some incredibly sophisticated
- LEGO's Mindstorm
- Vex Robotics
- Arduino
- BaneBots
- Etc.

- Some require that you attach your vehicle to a laptop or similar device, some not.
- Some had problems with time limits and getting the data downloaded in time
- At least one team at Nationals had their laptop battery die – and couldn't run their vehicle
- NO EXTERNAL Sensors allowed
- Can be VERY accurate – since it is a relatively easy robotic task.

‡ Additional Info

- SOSC Wiki
- Timer: The motor is turned on for an adjustable amount of time and then stopped. This can be done with a microcontroller or a one-shot 555 timer.
- Wheel/shaft counter: A sensor counts how many revolutions your axle makes and can stop the motor after determined # of turns. Often called an Optical Shaft Encoder
  - Vex Robotics

‡ Final suggestions

- Decide electronic or not early, then build!
- Calibrate, calibrate, calibrate
- Be as consistent as possible
- Record data, graph it, do more trials
- Did I say calibrate?
- MAKE sure that it goes straight!!! - unless you want to attempt the bonus!!
  - Use alignment/sighting tools to help here
- Obviously, BE FAST AND ACCURATE!!!

THE END!