Top Level

F1 Transform electrical energy to mechanical energy

- **C1a** DC motor
- **C1b** Explosives
- **C1c** Jet Engine
- **F2** Detect turns
- **F3** Turn relative to ground
- **F4** Move up a hill
- **F5** Control speed
- **F6** Stay aligned with rails
- **F7** Contain components
- **F8** Connect to cargo carts

Sub-Functions (C1a)

- **sF1** Transfer energy from motor to wheels
  - **sC1a** Direct drive
  - **sC1b** Gear box
  - **sC1c** Belt drive
  - **sC1d** Chain drive
  - **sC1e** Friction drive
  - **sC1f** Fan or propellor

Sub-Functions (C1b)

- **sF1** Move explosives behind center of mass
  - **sC1a** Chute of gunpowder with a servo
  - **sC1b** Gravity fed tube
  - **sC1c** Small fan
- **sF2** Set Off Explosives
  - **sC2a** Lighter
  - **sC2b** Primer with pins
  - **sC2c** Arcing electricity

Sub-Functions (C1c)

- **sF1** Hold Fuel
  - **sC1a** Internal gas tank
  - **sC1b** External gas tank
- **sF2** Move fuel to engine
  - **sC2a** Gravity
  - **sC2b** Injection
  - **sC2c** Difference in air pressure
- **sF3** Expel fuel
  - **sC3a** Fan or propellor
  - **sC3b** Air compressor
- **sF4** Light fuel
  - **sC4a** Pilot light
  - **sC4b** Arcing electricity

Sub-Functions (C2a)

- **sF1** Detect resistance changes
  - **sC1a** Arduino

Sub-Functions (C2b)

- **sF1** Detect changes in acceleration/gyration
  - **sC1a** Arduino

Sub-Functions (C2c)

- **sF1** Detect differences in light reflected from track
  - **sC1a** Arduino

Sub-Functions (C2d)

- **sF1** Wait for preset time interval
  - **sC1a** Arduino

Sub-Functions (C2e)

- **sF1** Go slow enough to not need turn detection

Sub-Functions (C3a)

- **sF1** Adjust speed for each wheel to acount for difference in distance travelled
  - **sC1a** Geometry will account

Sub-Functions (C3b)

- **sF1** Allow for slip
  - **sC1a** Use material with low coefficient of friction

Sub-Functions (C4a)

- **sF1** Quickly accelerate
  - **sC1a** Lightweight chassis
  - **sC1b** Gear ratio

Sub-Functions (C4b)

- **sF1** Increased amounts of friction
  - **sC1a** Rubberized wheels
  - **sC1b** Adhesive
- **sF2** Sustain torque
  - **sC2a** Gear ratio
  - **sC2b** Multiple motors

Sub-Functions (C4c)

- **sF1** Move along its length
  - **sC1a** Ratchet
  - **sC1b** Pulley and motor powered
- **sF2** Launch arms forward
  - **sC2a** Crossbow
  - **sC2b** Pneumatics
  - **sC2c** Explosives
  - **sC2d** Slingshot
  - **sC2e** Catapult

Sub-Functions (C5a)

- **sF1** Apply pressure to wheels
  - **sC1a** Servo
  - **sC1b** Hydraulics
  - **sC1c** Pneumatics

Sub-Functions (C5b)

- **sF1** Force spike into ground
  - **sC1a** Servo motor
  - **sC1b** Heavy spike with release latch
  - **sC1c** Shoot spike into ground
  - **sC1d** Hydraulics
  - **sC1e** Pneumatics

Sub-Functions (C5c)

- **sF1** Apply pressure to wheels
  - **sC1a** Servo
  - **sC1b** Hydraulics
  - **sC1c** Pneumatics
  - **sC1d** Electromagnets

Sub-Functions (C5d)

- **sF1** Increase drag coefficient
  - **sC1a** Flip panels outward
  - **sC1b** Parachute

Sub-Functions (C5e)

- **sF1** Transform kinetic energy of motor to electrical/heat energy
  - **sC1a** Connect motor to storage battery/capacitor (regen braking)
  - **sC1b** Connect motor to resistor (dynamic braking)
  - **sC1c** Connect motor to power source in reverse (plug braking)

- **C2a** Potentiometer
- **C2b** Accelerometer/gyrometer
- **C2c** Light sensor
- **C2d** Preset time intervals
- **C2e** None
- **C3a** Conical wheels
- **C3b** Flat wheels
- **C3c** Slip differential
- **C4a** High momentum
- **C4b** High torque
- **C4c** Sticky arms
- **C5a** Drum brake
- **C5b** Spike
- **C5c** Disk brakes
- **C5d** Drag based brakes
- **C5e** Electric brake system
- **C6a** Conical wheels
- **C6b** Wheels with o-rings and flanges
- **C6c** Tank treads
- **C7a** Sit in box
- **C7b** Drill to plate
- **C7c** Adhere to plate
- **C7d** Potting
- **C7e** Welding
- **C8a** Screws
- **C8b** Rope/wire
- **C8c** Links
- **C8d** Pins
- **C8e** Glue