

## Lesson Outline and Notes

- a. Session 1: Structure
  - i. Introduction to Structural FTC Parts
  - ii. Allen keys and Wrenches (Exhibit)
  - iii. Strength of 3d Geometric Shapes
  - iv. Structural Physics
    1. (Weight) not too many bad things about being heavy in FTC.
    2. Center of Gravity
  - v. Drivetrains/Systems (Pros/Cons of each)
    1. Tank Drive
      - a. 4-Wheel
      - b. 6-Wheel
      - c. (Tank)
        - i. West Coast
  - vi. (Typical Chassis Shapes)
    1. Rectangle
    2. U Shape
  - vii. Activities
    1. Chassis Building
      - a. Building activity
      - b. Center of gravity activity.
- b. Session 2: Torque, power, & motors
  - i. Motors available
    1. Statistics
  - ii. (Motor Curves)
    1. <http://www.andymark.com/Motor-p/am-3104.htm>
    2. [http://www.cougarrobot.com/attachments/328\\_Tetrix\\_DC\\_Motor\\_V2.pdf](http://www.cougarrobot.com/attachments/328_Tetrix_DC_Motor_V2.pdf)
    3. [http://files.andymark.com/am-2964\\_testing.pdf](http://files.andymark.com/am-2964_testing.pdf)
    4. Performance analysis
  - iii. Gear ratios; torque and speed (Conceptual)
    1. <http://science.howstuffworks.com/transport/engines-equipment/gear-ratio.htm>
    2. <http://www.groschopp.com/gear-reduction/>
  - iv. Torque and Force
    1.  $\tau = F \times r$
  - v. Activity
    1. Locate good motors within a pile of broken motors
      - a. May be burned out or broken gears
    2. C channel gear system.
- c. Session 3: Power Transmission
  - i. Moving power/ Parts intro (be brief)
    1. Pulleys and Belts
      - a. RoboLancers West Coast Drive
    2. Winch and string or wire
      - a. Elevators
    3. Sprockets and Chain
      - a. Classic West Coast Drive

4. Gears (Practical)
    - a. Spur
      - i. Normal thing
    - b. Bevels and Miters
      - i. 90 Degree Transmission
    - c. Worm
      - i. Back-drive prevention and 90 degree transmission
  5. (Cantilevering)
  6. Dealing with friction
    - a. Low friction materials (Coefficient of Friction)
    - b. Ball Bearings
    - c. Sleeve Bearings
- ii. Activity
1. Use chain or gears to transmit power from 2 motors, installed (by us) on their chassis, to 4 wheels.

Part overview

[https://www.tetrixrobotics.com/extra\\_TETRIX\\_parts\\_for\\_FTC](https://www.tetrixrobotics.com/extra_TETRIX_parts_for_FTC)

## Class Time Outline (3 Sessions, one for each day)

- *Session 1: Structure*
  - **Introductions** ~ 10 minutes
    - Icebreaker?
    - Ask about experience with FIRST/ Robotics
  - **Structure Presentation** ~ 20 Minutes
    - Showcase of TETRIX parts ~ 5-10 Minutes
  - **Build a Chassis Activity** ~ 40 minutes
    - Divide class into 4 groups (Divide friends. Make new ones) ~ 2 Minutes
    - Build a Chassis Without Angle Brackets within 18x18 size limit ~ 28 minutes
    - List pros and cons of chassis within group. Turn in before end of class. ~ 10 minutes
  - **Homework**
    - Identify Parts on Google Form
- *Session 2: Motors*
  - **Introduction** ~ 5 Minutes (Can vary)
    - Questions about previous night's homework ~ (Time may vary)
    - Ask about previous knowledge of motors ~ 5 Minutes
  - **Motor Presentation** ~ 20 Minutes
    - Showcase motors ~ 5 minutes
  - **Activity** ~ 45 Minutes
    - Split into groups from session 1 ~ 2 Minutes
    - Provide each group with 8 motors (Broken and functional), ask them to identify the broken and functional ones, and hypothesize why the broken ones are broken. Must record. Turn in before end of activity. ~ 15 Minutes
    - Discuss the true reason the motors are not-functional. ~ 5 Minutes
    - Install 2 Motors and 4 or 6 wheels on the previous day's chassis ~ 23 Minutes
    - (Alternative session 2 extends motor analysis and motor and wheel installation is performed by us before session 3 classes)
  - **Homework**
    - Motor Review Google Form
- *Session 3: Power Transmission*
  - **Introduction** ~ 5 Minutes
    - Questions about previous night's homework ~ (Time may vary)
    - Question thoughts on "power transmission" ~ 5 Minutes
  - **Power Transmission Presentation** ~ 20 Minutes
  - **Activity** ~ 35 Minutes
    - Install either Chain and sprockets or Gears to drivetrain and chassis constructed from previous sessions ~ 30 Minutes
    - Record pros, cons, and possible failure points of the drive train as a whole ~ 5 Minutes

- Homework
    - Power Transmission Review Homework
- Presentation Materials
  - 1 Computer
  - 1 Smart Board
  - 1 Box of FTC Materials
- Session 1 Activity Materials (However many we can find)
  - Some more mechanical members depending on the number of students
  - C Channel
  - FTC Bolts
  - FTC Nuts
  - Allen Keys
  - Wrenches
- Session 2 Activity Materials
  - Tetrax DC Motors (Broken as well as functional)
  - 8 functional, FTC legal motors
  - 16 Motor Mounts
  - 16 Motor Hubs
  - 32 Axle Hubs
  - 48 Wheels
  - 32 Axles
  - 32 Shaft Collars
  - 64 Bronze Sleeve Bearings
  - Bolts
  - Nuts
  - Allen Keys
  - Wrenches
    - Alternative Session 2
      - Session 2 Alternative Activity Materials
        - 8 Tetrax DC Motors (Broken as well as functional)
      - Preparation for Session 3 Materials
        - 16 Wheels
        - 8 Functional, FTC legal motors
        - 8 Motor mounts
        - 8 Bronze bearing sleeves
        - 8 Motor hubs
        - 8 Axle hubs
        - 8 Shaft collars
        - Bolts
        - Nuts
        - Allen Keys
        - Wrenches
- Session 3 Activity Materials (However many we can find)

- Chassis built in Sessions 1 and 2
- Allen Keys
- Sprockets
- Gears
- Chain
- Chain breaker