Engineering Notebook

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What is an Engineering Notebook?

Problem Definition
Information Gathering
Brainstorming Solutions
Concept Design
System Level Design
Testing

Design Improvement
Production
Promotion
Budgeting
Planning
Outreach

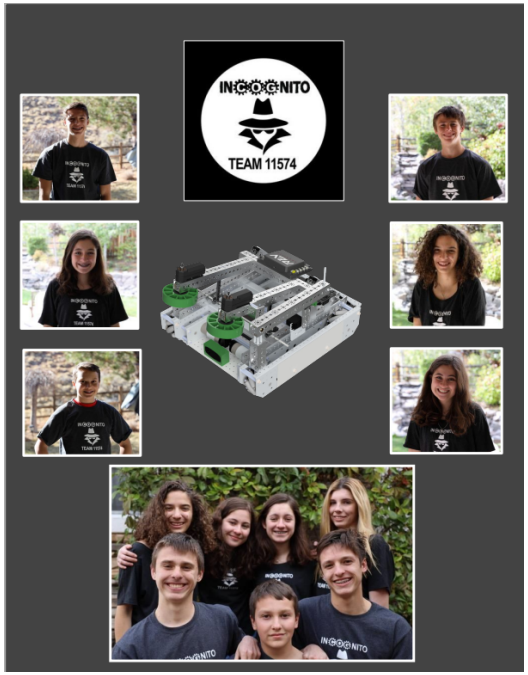
Why Do We Need a Notebook?

- Document obstacles, lessons learned, draw ideas
- Show the journey the team makes
- Judges can see the journey
- Show team from the beginning to end of season
- Required for awards

Notebook Requirements

- Check Updates Game Manual #1
- 2 Notebooks max
- Team number and team name on cover
- Should attach summary page – 1-3 pages
- Engineering Content

Name and Number



Summary Page

- One to 3 pages
- Include a concise narrative about the team
- Include team number
- Bulleted highlights of the team's season
- List of pages in the engineering notebook the team would most like the judges to consider

FTC Team 5326

Summary

These are the voyages of the FTC Team 5326
Its continuing mission is

to explore . . . the Robot & Design of

to seek out . . . Outreach, Fundraising, spreading FIRST

to boldly learn new things

Engineering Notebook Contents

- **Engineering Content**
  - Game Strategy
  - Design Process
  - Programming
  - CAD
- **Team Summary**
  - Information about Team
  - Members/coaches
  - Team Meetings
  - Outreaches
- **Team Plan**
  - Business plan
  - Strategic plan to meet goals
  - Sustainability Plan
- **Table of contents**
  - Makes it easier for judges to find documentation

Game Strategy

- Identify game challenges
- Show tasks points - ranked
- Show your strategy
- Strategy for challenges and why
- How strategy dictates robot
- Explain design

Plan B Game Strategy: 11/25/2017 - 12/29/2017

Drivetrain: Our previous drive train design was causing our bevel gears to slip. This made our driving very unpredictable. We did multiple designs in CAD to fix this issue which included CNCing several parts. We also changed to larger bevel gears. We were successful! Slippage was eliminated!

Glyph Grabber: Our previous glyph grabber could pick up 2 glyphs, but they easily fell out. To help ensure more predictability, we added a pink strip of foam to each arm. The foam helped eliminate slippage of the glyph, which meant we were able to more predictably pick up 2 glyphs. We also added a 2nd linear slide to improve stability. Our previous slide would wobble side to side which would reduce our grabbing control.

Autonomous strategy:
- Park in safe zone = 10 points

Teleop strategy:
- Score glyphs in the Cryptobox = 2 points each
- Completed Row of 3 in Cryptobox = 10 points each
- Completed Column of 4 in Cryptobox = 20 points each

End game strategy:
- Robot balanced on Balancing Stone = 20 points

Plan C Game Strategy: 01/06/2018 - Present

Driving Strategy: To reduce driver load, we decided to add a second driver. The main driver drives the robot; the second driver runs the grabber arm and linear slide. This reduces the pressure on the driver.

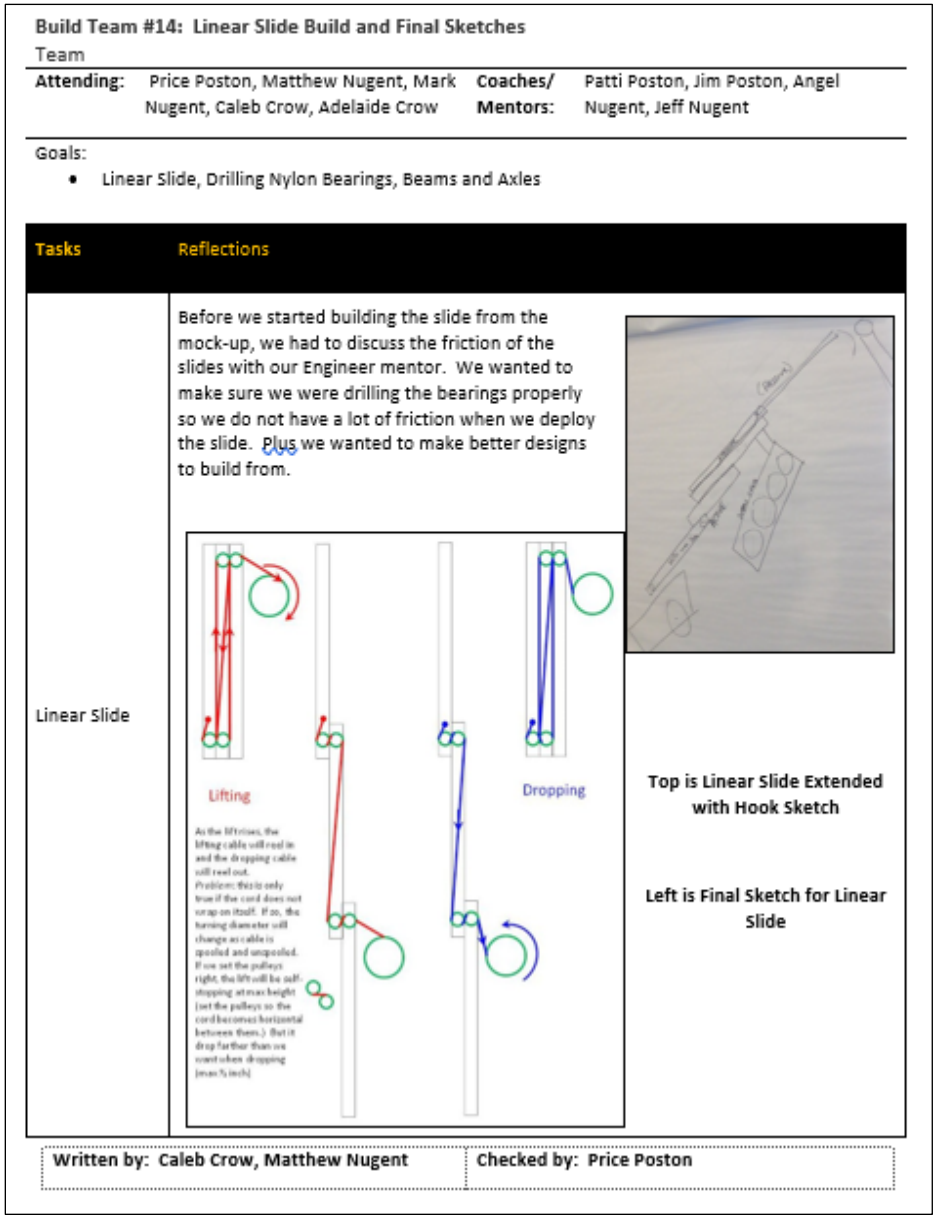
Drivetrain: Our previous drivetrain is working very well. Before each match, we do check every set screw.

Glyph Grabber: We removed our foam and replaced it with grip tape. This allows us to have a better grip on glyphs, which gives us more reliability in grabbing 2 glyphs. We also added heavy duty servos to our grabber arm. Our previous ones were weak, and we could not push glyphs or hold onto them. The stronger servos allow us to hold glyphs well and to push glyphs out of the way.

After much programming, we also have an autonomous program for loading a glyph in the cryptobox! We do this after we autonomously knock off the jewel from the jewel box. We have also created an additional component that can potentially grab 2 glyphs to score in

Design Process

- Document from game reveal – competition
- Sketches
  - Rough sketches - Napkins
  - CAD drawings
- Photos
- CAD Drawings
- Math Equations
- Electrical
- Document design and changes



Build Team #14: Linear Slide Build and Final Sketches

Team

Attending: Price Poston, Matthew Nugent, Mark Nugent, Caleb Crow, Adelaide Crow **Coaches/ Mentors:** Patti Poston, Jim Poston, Angel Nugent, Jeff Nugent

Goals:

- Linear Slide, Drilling Nylon Bearings, Beams and Axles

Tasks	Reflections
Linear Slide	Before we started building the slide from the mock-up, we had to discuss the friction of the slides with our Engineer mentor. We wanted to make sure we were drilling the bearings properly so we do not have a lot of friction when we deploy the slide. Plus we wanted to make better designs to build from.

Top is Linear Slide Extended with Hook Sketch

Left is Final Sketch for Linear Slide

Written by: Caleb Crow, Matthew Nugent **Checked by: Price Poston**

Programming Section

- Overview programming process
- Reasons for specific process
- Implications of a sensor
- Flowcharts & diagrams
- Controller setup
- Config of motors & servos
- DO NOT PRINT OUT ALL OF YOUR CODE!
  - Only parts that you want to explain or showcase

Autonomous

This following chart depicts our team's Autonomous goals, in order of importance.

- Accurate, consistent drive methods
- Deposit our team marker into the depot
- End autonomous in the crater parking area
- Accurately sample or double sample based on our needs, using computer vision
- Start hanging and consistently drop in a repeatable position
- Object Oriented Programming (OOP) integration and code portability
- Internally track robot position and update drive methods real-time
- Code clarity and elimination of repetitive code

A diagram of our final class hierarchy is featured below:

Note several top-level classes have been omitted for simplicity

Our code is broken into several "levels" of classes. At the start of this hierarchy, we have several classes that initialize the robot for different strategies. This was a necessity since the FTC app does not allow any data to be parsed upon the launch of Autonomous. These classes extend the LinearOpMode, overriding runOpMode as the class' sole method.

Because every drop from the lander and sampling is close to identical, we decided to go with a single method for all possible starting positions and strategies, known as AutoGeneric. Each of the prior classes calls AutoGeneric with a defined enumerator for starting in the crater, in the lander, and variations for strategies such as double sampling. This allows us to keep our Autonomous code neat, organized, and most importantly, easy to write. After a basic program skeleton is set up, the only thing that should ever need changed between paths and strategies for Autonomous are gameState goals. This allows us to spawn child programs in a matter of minutes, giving us the ability to adapt to nearly any situation competition manages to throw at us. The AutoGeneric java class consists of calls to a driver class, Navigation, which handles detailed robot-interfacing methods such as drivetrain control, motor and servo control, gyroscope tracking, and computer vision (Vuforia, DogeCV).

CAD Section

- Add sketches, designs,
- Measurements
- CAD Drawings
- Explain the reason for the design

4250 LIGHTSABERS 4250

DATE:	START TIME:	STOP TIME
December 1, 2014	6:15	9:00

TASKS	REFLECTIONS
CAD robot Jacob	Additions: • Made the popper plates to the 18" height limit • Added release bolt for popper • Shortened the ramp • Rotated some of the motor mounts • Added ball for reference • Lowered popper mechanism to 2.25 of the base plate

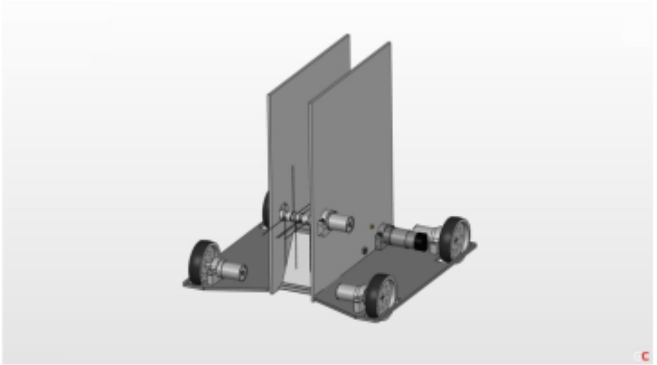
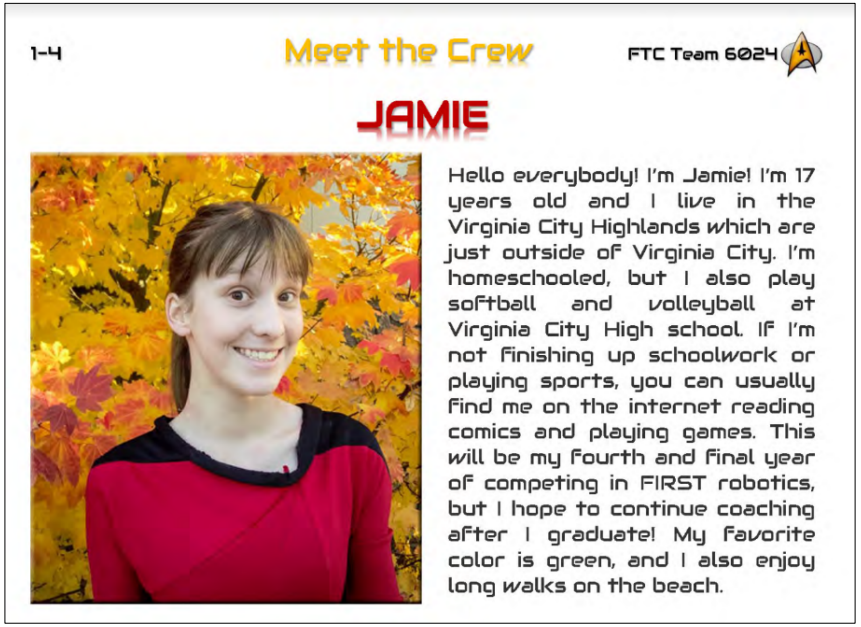


Figure 40 CAD/Plates and Popper

TASKS	REFLECTIONS
Wood Base Hannah Liao	Today my group had Hannah Fowler and Josiah Murphy in it. I was tasked with working with them to make a wooden base from the CAD Jacob had been making. Jacob gave us a printout of the measurements and I walked Hannah F. and Josiah through marking measurements on the wood for our cuts. After the measurements were marked, we cut out the base and the holes for the wheels. I

Team Summary

- Team member bios
  - School year
  - Interests
  - Activities outside of robotics
  - Team role
  - Future plans
  - What got them interested
- Mentor bios
  - Career
  - Team involvement
  - Personal history



- Information about team
  - Hometown
  - Age
  - School

Team Meetings

- Details about meeting
  - Date
  - Time
  - Location
  - Intentions
- What was completed
- What is ongoing
- Future plans

Meeting #3: Future pl… Open with Google Docs

Discussion Team

Attending: Nadya Dooley, Jamie Poston, Price Poston, Cole Kenny, Logan Peterson **Mentors:** Wade Peterson, Patti Poston, Ming Dooley

Tasks	Reflections
Discuss financing	We came up with a broad variety of ideas, from more camps to making and selling merchandise
Talk about outreach	We discussed the radio show, website, kickoff event, camps, and going to India
Plan upcoming meetings	We planned several Skype meetings, as well as a couple dates that Nadya and Ming will fly up on

Making Money

- We started the discussion by creating a general budget plan and immediately agreed that the main way we can finance the team is by having more FLL camps-- these camps are also a great outreach opportunity and good teaching experience for all the team members
- It was decided that there will be several camps in January, and possibly one in October
- Next, team members started coming up with smaller scale ideas. It was proposed that we could create and sell Star Trek merchandise, such as Lego mini figures, artwork, or possibly action figures created using the 3D printer we have access to
- Jamie proposed the idea of selling Hex bugs, as Logan's family owns a toy store and can look into getting them for inexpensive
- We also decided we could start a kickstarter, and Cole volunteered to make a video for it

Reaching Out to the Community

Outreach Section

- Entry for each event/experience
- Photos of the event
- Explain the significance and impact
- Give many details
- Include takeaways
- Who was at the event
- FIRST, Community or Professional Outreach?

SimCity

- We installed SimCity on all 12 computers at the camp.
- We had 23 students in the camp with 1 - 2 students on each computer.
- We taught the students how to use the SimCity program to build a city.
- Once the students understood what they were doing we gave them a mini competition to do with building a city and including the following services: community service buildings, airport, streets, public transportation, utilities and places for the Sims to live. The team that had the most items in their city won the competition.
- We awarded the prizes and cleaned up the room.
- Below is a picture of the winning solo team and the winning duo team.

Credits

- This lesson was written by Patti Poston
- You can contact the author at: pposton@firstinspires.org
- More lessons for FIRST Tech Challenge are available at www.FTCtutorials.com
- Image Credit: 6024 Enterprisers, 5326 Enterprisers, 11574 Sonic Screwdrivers, 10464 Bionic Tigers, 4250 Light Sabers, 5687 Cyber Mafia