4-H Robotics Delivery Challenge: Autonomous Package Delivery

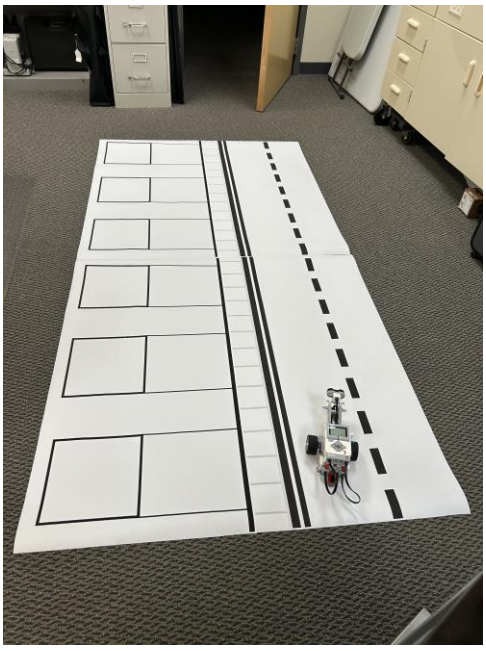
Theme:

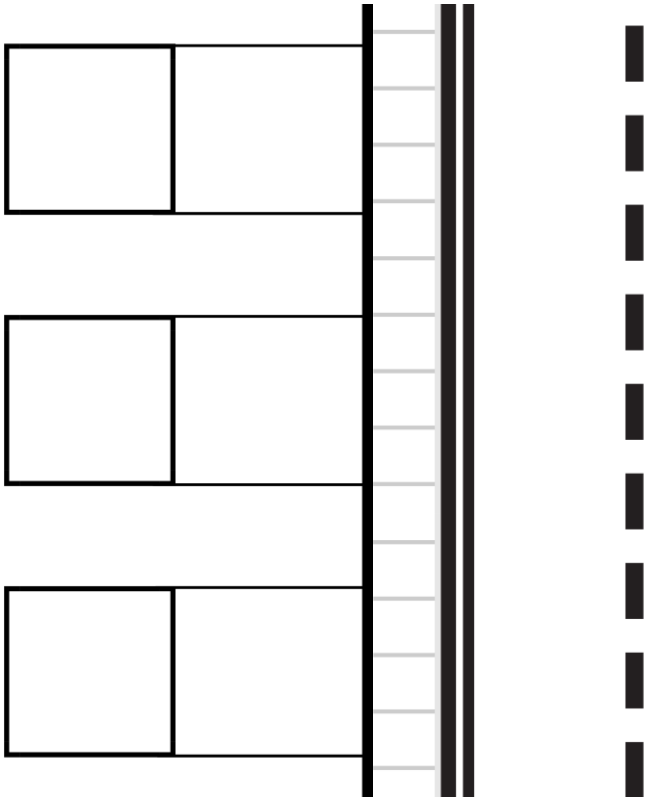
Design and program an *autonomous* robot to deliver packages to the correct houses in a neighborhood while avoiding obstacles and protecting property.

Competition Overview

Participants will design and program fully autonomous robots capable of identifying, collecting, and delivering color-coded packages to matching homes on a 4x8-foot game mat. Robots must complete deliveries while avoiding obstacles such as parked cars, dogs, and fire hydrants.

Robots earn points based on accuracy, placement, and adherence to rules of safety and efficiency.





Eligibility

- Open to youth in grades **9–12**.
- Teams may consist of **2–4 members**.
- Each team must use a **single robot** per match.
- Robots must be **autonomous** (no remote control after start).

Robot Requirements

- Platform: Teams may use **LEGO SPIKE Prime, VEX IQ, VEX V5, Arduino, Raspberry Pi, or similar systems** capable of full autonomy.
- Size limit: Robot must start within a **13"x13"x13"** cube and expand another 5 inches in any direction after being placed on the field, making the robot a maximum of 18 inches long.
- Power: Battery-powered only, no external power or tethers.
- Sensors: Any onboard sensors may be used (color, distance, camera, gyro, etc.).
- No Wi-Fi, Bluetooth, or remote control during run (except to start the program).

Game Field Description

- Field size: **4 ft x 8 ft** mat with printed "neighborhood" layout.
- Elements include:
    - **Truck zone:** Starting area containing all packages for delivery.
    - **4–6 houses:** Each marked with a distinct color.
    - **Driveways, yards, sidewalks, and mailboxes** for each home.
    - **Obstacles:** Parked cars, dogs, fire hydrants, trees, and curbs.

Note: Layout and obstacle placement will be consistent for all teams during a given round.

Game Objective

Deliver as many packages as possible to the correct colored homes **accurately** and **safely** within the time limit.

Delivery Rules:

- Packages are **color-coded** to match the target house.
- Packages begin at the truck zone and must be autonomously delivered to the correct home.
- Some houses will have a **return package** (marked differently) that must be picked up and returned to the truck.

Match Format

- Each team has **2 minutes and 30 seconds** to complete as many deliveries as possible.
- Robots must start completely inside the **truck zone**.
- Teams may touch or reset their robot only by forfeiting a **10-point penalty** and returning it to the truck zone.
- Robots must be autonomous from start to finish (only one start button press allowed).

Scoring System

Action	Points Possible	Points Earned
Package delivered on **doorstep**	+30	
Package delivered on **driveway**	+20	
Package delivered by **mailbox**	+15	
Package placed in **yard**	+10	
Returned package successfully to truck	+25	
Avoiding all obstacles (clean run)	+20 bonus	
Minor property contact (bump without damage)	-5 each	
Major property damage (drive over yard, hit obstacle, etc.)	-10 each	
Manual reset/touch	-10 each	
Delivery to wrong house	-15	
Exceeding time limit (stopped robot manually)	0 additional points	

Time Efficiency Bonus

If a team finishes all deliveries (either all packages delivered and/or returned) **before the 2 minute 30 second limit**, they receive bonus points based on the time remaining:

Time Remaining	Bonus Points
0:30 – 0:59 remaining	+10 points
1:00 – 1:29 remaining	+20 points
1:30 or more remaining	+30 points

Competition Rounds

1. **Practice Round:** 1 official practice run per team.
2. **Qualifying Rounds:** 2 matches; best score counts.
3. **Finals:** Top 3–5 teams advance for a single championship match.

Judging & Tie-Breakers

Judges will evaluate based on:

1. **Highest score achieved**
2. **Fastest time** to complete all deliveries (if tied on points)
3. **Engineering Design Notebook** (– Required – worth 525 points. Rubric on website, including judge interview.

Safety & Conduct

- Robots must not launch, throw, or eject parts or packages.
- Youth participants must do all programming.
- Coaches may assist in setup but not in operation.
- Respect for judges, other teams, and materials is mandatory.

Engineering Notebook Criteria

Engineering Notebook

Adapted from University of Idaho Extension "All about the FTC Engineering Notebook".

Why an Engineering Notebook?

An engineering notebook is a working document. It is where ideas, sketches, and team thoughts are recorded in addition to the final production information about your team and robot. It is a journal your whole team will use to help everyone know what's going on, where you record your testing data, and it is a record of your abandoned ideas and prototypes.

1) Engineering notebooks show the thought behind your strategy, designs, innovations, and organization. They show how each team member contributes and how your team overcomes obstacles. These things are hard to see at an event when you are there with a finished product.
2) Your engineering notebook is the primary reference for your team. It records all thoughts at meetings and events, all ideas for robot design, all changes to the code (although the actual code does not need to be included), and game strategy. The notebook is a tool for the entire team to communicate together. It should be used as a reference for the team as well as for the judges.
3) Engineering notebook is a tool you can use to show how your team works, what you do, and the concepts you are exploring with your sponsors and potential sponsors.

Should I follow this formatting guideline?

The short answer is yes, some of the guidelines are presented as optional, but by closely following the guidelines you make your engineering notebook easier for the judges to understand and eligible for the Think and Inspire awards.

If you plan to use a handwritten notebook it is a good idea to divide the sections before you start writing, or decide if you want to use multiple small notebooks to document your season. Keep in mind that your meeting discussions are as important as your engineering, game strategy, and programming thoughts when considering the awards. Showing how your team uses all of its strengths to overcome engineering challenges is critical – and that includes all aspects of the team. You also have the option of using an electronic notebook. These can be easier to use if you are meeting in different places, as long as you have access to it, no one will have forgotten to bring the notebook. While the judges do not differentiate between a handwritten notebook and a printed one, there are pros and cons to each your team should consider.

Table 2 – Dos and Don'ts for Your Engineering Notebook

Handwritten Engineering Notebook	**Electronic Engineering Notebook**
Pros: Easy to use – everyone can write on paper • Already printed and bound, what you see is what you have • Easy to show how the whole team contributed with different writing styles, ink, and signatures • Easy to reference during the build season • Shows it's use with stains, cross outs, and worn pages • Easy to add tabs and make ready for competition (the pages your team referenced the most will be the ones the judges want to see.)	**Pros:** • Available anywhere (if in the cloud) • Spell Check, and legible • Easy to add images and summaries, and they won't fall out • No worries about running out of pages in a section and running into the next section • If you forget it at home, it can be reprinted anywhere. • Can print a new copy to mark for each competition. – although not necessarily advised
Cons: • Each section needs to be decided at the beginning of the season, it's not possible to change mid-way through. If you don't have enough pages you have to use pages in the back or a second notebook. • Not everyone has really legible handwriting, or spelling, but everyone does need to contribute. • Must be remembered everywhere you go, especially tournaments.	**Cons:** • Not easy to tell that everyone has contributed to the notebook. • Need to remember to print and get it in an appropriate binder for each tournament. • Sometimes needs reformatting to print nicely. • Adding hand drawings, pictures, PTC renderings takes more effort.

Now that you have decided on your notebook/notebooks, get out a sharpie and put your TEAM NAME, and COUNTY on the notebook. This is one of the most important things you can do! It not only helps the judges find your notebook in the mountain of engineering notebooks at a tournament, but it lets those same judges know you care about your notebook and can follow basic instructions. No matter how nice your cover is, if a judge has to hunt to find your team name and county, it does not leave them with a good impression – even before they look inside. Remember the judge is your advocate to being considered for awards, you want them to have a positive impression of the team in every way possible.

Requirements of Your Engineering Portfolio/Notebook:

- Portfolio should be organized in a logical manner.
- Engineering portfolio must have engineering content. The engineering content could include entries describing examples of the underlying science, mathematics, and game strategies in a summary fashion.
- The engineering portfolio must provide examples that show the Team has a clear understanding of the engineering design process including an example of lessons learned.
- The portfolio should inspire the judges to ask about specific, detailed engineering information.

- Portfolio format is less important but enables the judges to understand the Team's design maturity, organizational capabilities, and overall Team structure.
- Portfolio could reference specific experiences and lessons learned but should capture the summary of the status of the Team and their Robot design.
- Portfolio could summarize experiences and lessons learned from outreach with concise tables of outcomes.
- Portfolio could summarize how they acquired new mentors and/or acquired new knowledge and expertise from their mentors.
- Portfolio could contain a summary of overall Team plan.
- Portfolio could contain information about the plans to develop skills for Team members.

Getting Started

Everything is going in this notebook, but right now it's a blank page or screen. So how do you get going?

- Make sure your Team Name and County is on the cover – both are required
- The next thing you need to do is set aside the first page for your team summary. You will want to do a draft of this page. It is the first impression you give to the judges! They will see your team summary before they even meet your team! Alternatively, you can fix your team summary to the backside of the front cover.
- Label the next page table of contents. As you set the sections you will start filling this in! This will help keep your notebook organized and where you will highlight key pages you want the judges to look at.
- Divide the sections. You are welcome to organize the engineering notebook into more categories if you like, but remember, the chronology and connectedness between everything you do is important to the judges, especially strategy, design, build, and programming all work together to make your season.
    - You want a Team Profile section where each team member is introduced, preferably with pictures.
    - Your Engineering Section will be the bulk of your notebook. It will include all your team meeting notes, designs, programming thoughts, strategy ideas, and reflections. Each meeting will need its own page and you will want additional pages for your engineering notes.
- Add your first meeting to the table of contents, and create an entry in the Engineering section. On your tasks column include setting up your engineering notebook and your contribution policy; remember EVERY team member should contribute to the notebook! Don't forget the team reflections on the meeting – this is a good place to get contribution, by having each team member present take the pen (never use pencil!)

Stick with your notebook policy for every meeting! Everything needs to be in the notebook.

What do You Mean When You Say Everything Goes in the Notebook?

Every meeting, add the meeting to the entry to the table of contents, and then write your tasks and reflections. Every credible idea discussed needs to be included in the notebook – even the ideas that don't work out. Do not self-censor your notebook! If you use a whiteboard to draw out ideas, take pictures, or have a team member sketch the ideas into the notebook. Make sure you leave space on meeting pages for photographs of what was happening – OUTLINE THEM IN INK and follow the picture inserting guidelines, pictures do occasionally fall out.

If you find yourself wondering if you should include something in the engineering notebook, do! Judges love the little bits of information that make your journey real like; ideas you discard because they are out of budget, when you sacrifice strategy because of a programming limitation, drawings sketched on napkins, the inconsequential details of a meeting – like celebrating a team member or coach's birthday, although honestly, judges don't need to know if the cake was good.

Tournament Time

You've done good, you've brought your engineering notebook to all team meetings and it's been a great resource for your team over the season. You've saved it from near fatal disasters. Your team has poured their heart and designs into it. Maybe you've even shown it to a few potential sponsors? But it is tournament time, and that's when the engineering notebook transforms from a working document for the team to keep their thoughts, ideas, and designs, into the written transcription of what makes your team special.

Now is the time to go back and flag pages for the judges. What entries really tell your team's story and show their strength? Where are your PTC or other design sketches? Where are the best pages to learn about the team's innovative idea? What about the Control Award? Great! You have your flags, you've highlighted your table of contents for the judges.

- Look at the front cover, is your TEAM NAME and COUNTY there and easy to read? Make it bolder if you need to – if you can put it on the binding too.
- Is your team summary on the first page or fixed securely to the inside of the front cover?
- Is your table of contents completely filled in with key entries highlighted for the judges?
- Every team member has a bio and their photo in the Team Section?
- Your Engineering section has all of your meetings, your designs, your notes and reflections?

  Have the key entries been flagged for the judges?
- Your Bill of Materials is fixed into your notebook and added to the table of contents so the judges can find it quickly. Did you print a second copy for inspection?
- Page-by-page:
    - All pictures have ink borders with the page number on the back of the photo should it fall out?
    - All white space is removed?
    - Every page has a page number. It's okay, if the numbers restart for each section.
    - All corrections are crossed out a single time and dated?
    - Everything fixed to the pages is secure and not coming loose?

Review this document again. Remember to turn in your notebook when you check in at the tournament. The longer the judges have with your notebook, the more they can get from it. The judges should receive your notebook shortly after they arrive. You can still feel free to point out key passages in the judging room, just don't use all your time flipping pages – your flags can help you here.

After the tournament, remember to pick up your engineering notebook!