Before we begin:

- **Please introduce yourself in the chat:** Name. School.

- Please mute your microphone to reduce background noise.

- We will leave time for Q&A. **Please submit your questions via the Google form that will be shared in the chat**.

- This presentation, along with the questions and answers, will be posted on the WESO website.

Zip It!

WESO 2025

Event Supervisors:
Terence Groening, Shwetha Rajaram

Goals for this event:

1

Physics Skills
Concepts for zip line - friction, air resistance, gravity and average velocity

2

Creativity
Encourage creativity and flexibility in building with materials unknown in advance

3

Teamwork
Working together to solve a challenge

Event Format

Grades	2, 3, 4, 5
Team Size	1-3 participants (per grade)
Duration	30 minutes

Event Overview

Written test for grades 4 & 5 ONLY (5 minutes)

- 2-3 multichoice, one free response average velocity calculation

Hands-on build phase for all grades (23 minutes)

- Using a few household materials, each team will construct a cable car to safely carry a ping-pong ball down a zip line to achieve a target run time

- Build the cable car (8 minutes)
- Testing and modifying the cable car (15 minutes)

Phase 1: Written Test (grades 4 & 5 only)

- 2-3 multiple choice questions testing the physics concepts of the zip line (friction, air resistance, gravity)

- 1 free response question - average velocity calculation using sample data
  - $v_{avg} = \Delta x / \Delta t$
  - where Δx is change in position and Δt is change in time
  - This formula will **not** be provided in the test

- Sample data will be in SI units, and the final answer should be provided in SI units as well *(m/s)*

Phase 2: Build the Cable Car

- Target time and zip line dimensions will be disclosed to teams

- Using the materials provided, each team will build a cable car to safely carry a ping-pong ball down a zip line

- A test zip line (not the same dimensions as the competition zip line) is available

- Provided tools: scissors, tape, glue, calculator, zip line harness

Materials could include :

- 3oz Dixie Bath Cups
- straws
- construction paper
- washers
- cardboard tubes
- paper clips
- yarn
- zip ties
- rubber bands
- pipe cleaners

Phase 2: Building constraints

- The harness is <u>not</u> allowed to be modified in any way.

- The ping pong ball is <u>not</u> allowed to be modified in any way.

- The ping pong ball "passenger" <u>cannot</u> be glued, taped or encased in the cable car.

- Each team will have 30 seconds to attach the cable car to the harness.

Phase 3: Test & Modify the Cable Car

- 3 cable car runs

- Teams place ping pong ball in cable car, attach to zip line harness, and release

- After 1st and 2nd runs, team has 2 <u>minutes</u> to modify using the remaining materials

- Run time is measured using photogates *(to ten thousandths of a second, i.e., 0.0001s)*
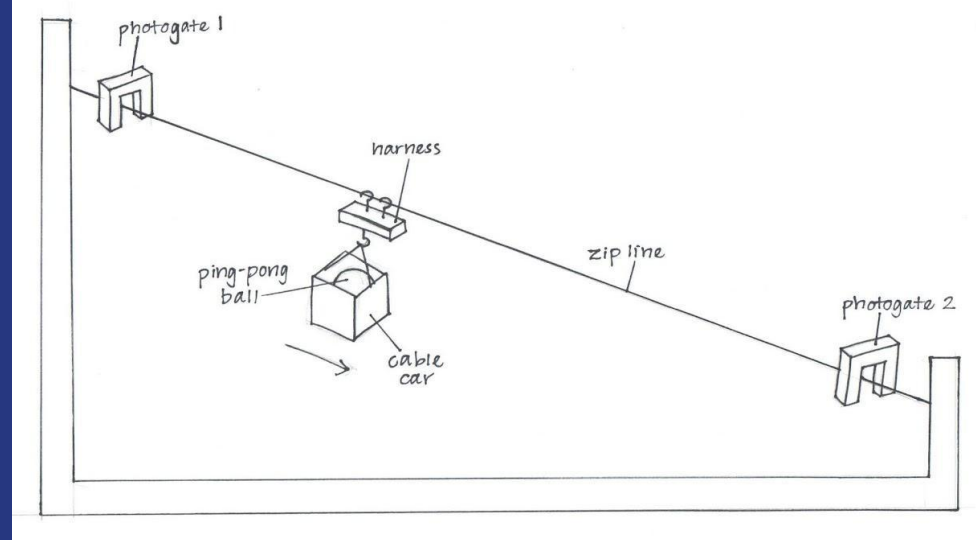
- Vertical drop: 1.2-1.5 m (4-5 ft)
- Horizontal drop: 3.0-4.6 m (10-15 ft)
- Height of the cable car < 0.3 meters (1 foot): distance from the second photogate to the base

Scoring

- Only the best run time (closest to the target time) of the three trials for each team will be considered

- The team(s) with the least deviation from the target time will be given a cable car rank of 1. The team(s) with the second lowest deviation will have a score of 2, and so on.

Grades 4 & 5

- Teams will also be ranked based on their written test score, with the highest scoring team(s) receiving a rank of 1

- Final score = cable car rank + 0.2 * written test rank

Scoring Penalties

We will not score the runs where:

- The cable car does not successfully traverse the entire distance of the zip line
- The ping-pong ball falls out of the cable car during the run *(it's acceptable for the ball to fall out after it passes the 2nd photogate)*

Teams will not be permitted to rerun their cable cars in these cases.

Example Test Question (Grades 4 & 5)

What force causes the cable car to accelerate down the zip line?

a). Friction

b). Gravity

c). Air resistance (drag)

d). Spring force
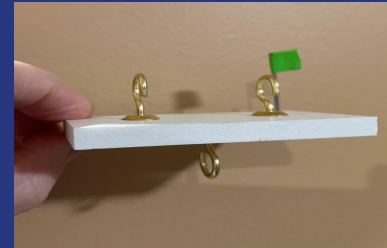
Event Materials distributed by WESO

Invisible Cord for Zip Line

Hillman Fasteners Invisible Cord, 25' long, 15lb rated.

Cable Car Harness

1.5" x 3" Komatex block with 2 cup hooks for Zip line and one cup hook to hang the cable car. Flag triggers photogate.

Ask your Head Coach for these items!

Additional Materials useful for practices

Household materials

- 3oz Dixie Bath Cups
- straws
- construction paper
- washers
- cardboard tubes
- paper clips
- yarn
- zip ties
- rubber bands
- pipe cleaners

Other supplies

- Scissors
- Tape
- Ping Pong Ball
- Method for timing runs
  - Stopwatch
  - Photogates

Coaching Advice

- Encourage team to think about how to increase/decrease run time

- Release from the same point, in the same way each time - consistency is key!

- Creativity is important, teams will not know what materials they have to build with until they arrive

- For grades 4 & 5, make sure they know how to calculate average velocity

- You do not need a fancy set up to practice for Zip It

  - We will hold open practice times on the competition equipment. Visit wesoscience.org for specific times.

- Don't over coach your team!

- Make sure they support each other

- Most importantly, make it fun!

Questions after tonight?

- New for 2025 - WESO Discord Server
- Every WESO event will have its own channel
- Join the WESO server to submit your questions in the event chat
- Event supervisors or WESO board members will monitor the discussion and answer questions
- Event coaches can use the chat to exchange coaching ideas
- Go to wesoscience.org/events/ for details on how to join the WESO server and guidelines for its use

Questions now?

- Please submit your questions now using the Google form that was shared with you in the chat.

- We will answer live and post all questions and written answers to the website after the meeting.

Thank you for serving as an event coach!