Gravity Vehicle (Coach Scheduled Testing - 45 Minutes)

Description: Teams will build a vehicle out of K'nex materials to travel a distance and stop as close to a designated finish point as possible. All building of vehicles will take place during the competition. This event has a written assessment on simple machines and the impacts of gravity and friction on wheeled vehicles.

Participants per assigned Team Number: 2

- If your school has 1 team you will send 2 students
- If your school has 2 teams you will send 2 students per team number; team numbers may not intermix
- If your school has 3 teams you will send 2 students per team number; team numbers may not intermix

Spirit of the Problem:

- The goal of competition is to give one's best effort while displaying honesty, integrity, and good sportsmanship. Everyone is expected to display courtesy and respect (see Science Olympiad Pledges below). Teams are expected to make an honest effort to follow the rules and the spirit of the problem (not interpret the rules so they have an unfair advantage).
- It is a rules violation if coaches, parents, mentors, or spectators enter the competition area or communicate with the team members at any time during the competition. Violation of this rule will place the team below all other teams.

Safety Teams Must Bring:

- **Safety glasses labeled ANSI Z87+ (impact rated)**
- **All competitors must wear their eye protection during any competitor's flight phase of the competition.**
- **If a team does not have the required eye protection, they will be given the opportunity to obtain it, time allowing, but will not receive extra time.**
- **If a team is unable to obtain eye protection, the team will not compete and will receive a no-show score.**

Category B: Impact Safety Glasses Required

Eyeglasses are not safety rated!

Teams need to bring:

- A writing utensil
- Optionally - 1 vehicle concept diagram, no larger than 8.5" x 11"
- No other resources or tools allowed

Materials Provided at Event:

- K'nex Building materials
- Gravity Car Ramp 1 meter in height
- Golf Ball
- Score sheets, stop watches, and distance measuring devices

The Competition (25 minutes):

1. **Written assessment**

a. This assessment will cover the six simple machines and the impacts of gravity and friction on wheeled vehicles.
b. During the assessment the Event Supervisor will record the team estimate of how close they will come to the target
c. The assessment will be between 10 and 20 questions in length and will take place simultaneously will the vehicle building

2. <u>Construction Phase:</u>

<u>The team will:</u>

a. build a wheeled vehicle out of K'nex pieces to travel 5.0 meters and come to a stop on a target point
b. power their vehicle solely by the gravitational energy of rolling down the ramp
c. build their vehicle with a fixed point (e.g. a K'nex piece) extending from the front edge of the vehicle, 1-2 cm above the track surface
d. build their vehicle to transport a golf ball to the target spot
e. the golf ball must remain in the vehicle until the Event Supervisor completes the competition measurements
f. have a maximum of 25 minutes to construct and test their vehicle
g. time permitting, may have up to 3 test runs with their vehicle during the build time
h. not modify their vehicle after the construction period has ended

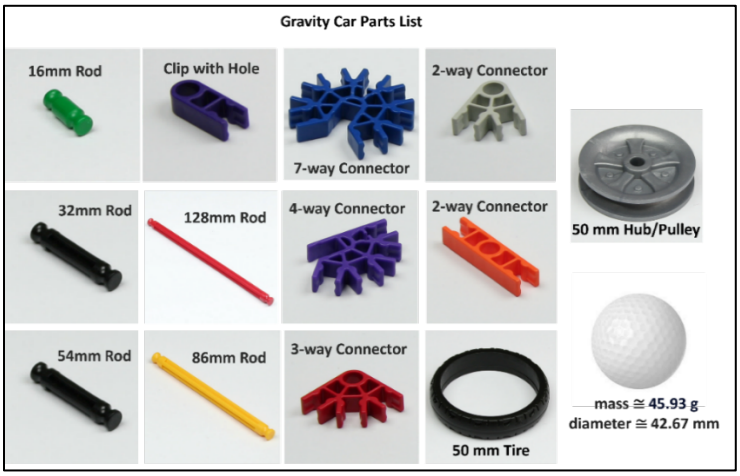
3. <u>The Ramp:</u>

a. will have multiple start lines at 20 cm intervals
b. will be 1 meter tall and long
c. will be 30 cm wide
d. will have a 10 cm concave bend

4. **<u>The Track:</u>**

a. will be a relatively smooth, hard surface
b. have a target point marked at 5.0 meters
c. have a center line from the center front of the ramp to the finish point
d. have a width of one meter

5. **<u>The Materials:</u>**



6. **Official runs:**
    a. **The team:**
        i. will have 2-minutes to make 2 official runs and will notify the Event Supervisor when they are ready (the run closest to the target point will count towards the team score)
        ii. may position the vehicle on the ramp at any of the start lines and in any orientation
        iii. may adjust the angle of the ramp left or right of the center line, but may not move it forward, backward or side to side
        iv. will need permission from the Event Supervisor to release their vehicle to start official runs
        v. will start their run with a 4-point count down, such as 3, 2, 1, go
        vi. use a one or two hand release and will not push the vehicle
        vii. will not chase their vehicle down the track, they must wait until they are called by the Event Supervisor to retrieve their vehicle

7. **Tier Violations**
    a. A tier violation is a penalty to a team for not following the build guidelines or the spirit of the problem as judged by the Event Supervisor. Teams placed in tiers 2 or 3 will receive scores reduced by 500 and 1000 points respectively.
        i. Tier 1. The team vehicle meets all the building requirements, and the team follows the Spirit of the Problem guidelines
        ii. Tier 2. The team vehicle is deemed to have a construction or time fault violations and the team follows the Spirit of the Problem guidelines
        iii. Tier 3. The team did not follow the Spirit of the Problem guidelines
    b. Possible construction or time violations
        i. The golf ball does not stay in the vehicle
        ii. A K'nex piece falls off the vehicle
        iii. The team continues to build after the 25-minute time
        iv. The team tries to rebuild or repair after their first official run

8. **Event Supervisor Records:**
    a. The estimated distance given by the team
    b. The distance from the target point to the fixed point at the front to the team vehicle
    c. Written test scores

9. **Scoring:**
    a. Acronyms
        i. Competition Distance Score (CDS) = the closest distance measurement from the target point to the fixed car point for all teams
        ii. Competition Assessment Score (CAS) = the highest assessment score for all teams
        iii. Final Score (FS)
        iv. Team Distance Score (TDS)
        v. Team Assessment Score (TAS)
    b. Final Score (FS) = (TAS) + (TDS). The maximum score is 100 points.
        i. Assessment Score = (TAS ÷ CAS); rounded to the 100th place value
        ii. Distance Score = (CDS ÷ TDS); rounded to the 100th place value
    c. Example
        i. (CAS) = 13. The team scores 6 on the assessment. (TAS) for the team= (6 ÷ 13) = 23.07 points
        ii. (CDS) = 0.5 cm. The team's distance score is 25 cm. (TDS) for the team= (0.5 ÷ 25) = 0.2 points
        iii. (FS) = 23.07 + 0.2 = 23.27 points

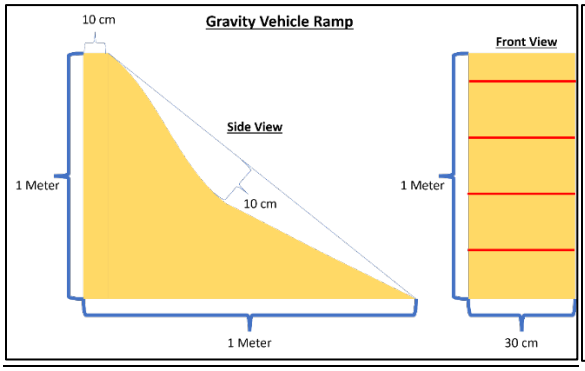
10. **Tiebreakers**

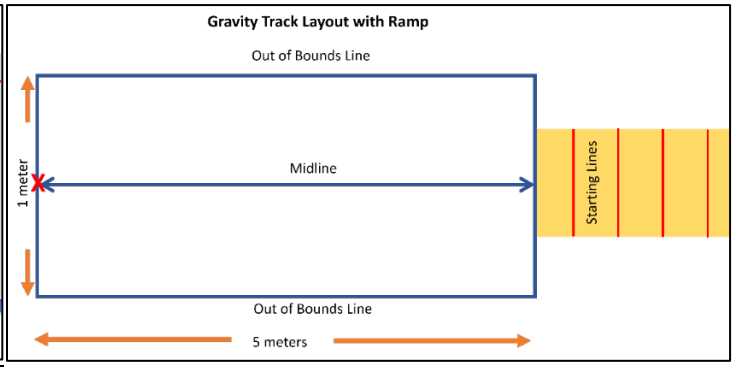
a. The smallest difference between the actual and estimated flight times
b. Correct answers on selected written assessment questions

Possible Resources

a. Division A will not release previous tests, or the exact resources used by the Event Supervisor or test writer for any events.
b. Use the listed resources and study guides as starting points. The study guide was created using Gemini AI and is meant as a beginning foundation! It may or may not contain topics occurring within the competition. It is up to the competitor to research further.
    i. NASA – Space Place – What is Gravity?
    ii. NASA - STEMonstrations: Friction
    iii. NASA - STEMonstrations: Simple Machines

Diagrams





Gravity Study Outline

Caution, this is a sample outline. It was Gemini AI generated and is meant as a starting point! It may or may not contain topics occurring on the written test.

1. **Simple Machines**
    a. Definition and Purpose:
    b. What is a simple machine?
    c. How do simple machines make work easier? (Explain the concept of work and how machines change the force or distance required)
        i. Types of Simple Machines:
2. **Lever:**
    a. First-class lever (e.g., seesaw)
    b. Second-class lever (e.g., wheelbarrow)
    c. Third-class lever (e.g., tweezers)
    d. Examples of levers in everyday life
3. **Pulley:**
    a. Fixed pulley
    b. Movable pulley
    c. Block and tackle system
    d. Examples of pulleys in everyday life
4. **Wheel and Axle:**
    a. How they work together
    b. Examples (e.g., doorknob, steering wheel)
5. **Inclined Plane:**

a. How it reduces the force needed to lift an object
b. Examples (e.g., ramps, stairs)

6. **Wedge:**
    a. How it splits or separates objects
    b. Examples (e.g., knife, axe)
7. **Screw:**
    a. Inclined plane wrapped around a cylinder
    b. Examples (e.g., jar lids, screws)
    c. Mechanical Advantage:
8. **How different simple machines affect mechanical advantage**
9. **Gravity and Friction on Wheeled Vehicles**
    a. Gravity:
        i. What is gravity?
        ii. How gravity affects the motion of a vehicle (e.g., downhill acceleration, uphill resistance)
10. **The role of gravity in braking**
    a. Friction:
        i. Types of friction (rolling, sliding)
        ii. How friction affects the motion of a vehicle (e.g., resistance to movement, tire wear)
        iii. The importance of tires and road surfaces in reducing friction
            1. Combined Effects:
        iv. How gravity and friction work together to influence vehicle speed and control
        v. Real-world examples (e.g., skidding, cornering)
        vi. Applications and Connections
            1. Everyday Life:
11. **Identifying simple machines in everyday objects**
12. **Understanding how gravity and friction impact daily activities (e.g., riding a bicycle, driving a car)**
13. **Technology and Engineering:**
    a. How engineers use simple machines in the design of vehicles
    b. Technological advancements in reducing friction and improving vehicle efficiency (e.g., aerodynamics, suspension systems)
14. **Assessment Preparation**
    a. Analyzing real-world scenarios involving gravity and friction
    b. Study Tips:
        i. Create flashcards
        ii. Form a study group
        iii. Review key concepts regularly
        iv. Note: This is a general outline, and you can adjust it based on the specific learning objectives and grade level of your students.