

Design Before Building

Use clear criteria and real limits to define an engineering problem.

MS-ETS1-1 “Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may...”

NAME _____

DATE _____

1 READ AND MARK _____ Read it twice

YOUR JOB Underline each measurable criterion, circle each constraint, and number the statements that describe a scientific principle or a possible impact on people or the environment.

A Catcher for Creek Litter

- ① At Cedar Middle School, rain washes snack wrappers from a paved courtyard into a storm drain that empties in Pine Creek. The engineering team wants to keep litter out of the creek without blocking rainwater. Before sketching a device, they observe that water flows downhill and that a clogged drain can flood a walkway. Their design problem is not simply “make a filter.” It is to create a removable litter catcher for this particular drain while keeping the courtyard safe during storms.
- ② The team writes measurable criteria before building. The catcher must trap at least 80 percent of test litter, allow water to drain after a 15-minute spray test, and be removed by one adult in under two minutes. These are criteria because they describe what a successful solution must do. The team also chooses a mesh opening small enough to hold wrappers but large enough for water to pass through. Testing different openings matters because smaller holes catch more debris but can slow water flow.
- ③ Several limits narrow the choices. The school can spend no more than \$120, and workers may not drill into the old concrete drain rim. The catcher must fit inside an opening 30 centimeters wide. Materials that rust quickly could break and send pieces downstream. A design that stops all leaves might also trap small animals or require workers to clear it too often. The team will compare choices for cost, safety, maintenance, and effects on creek life before selecting a solution.

2 ANSWER WITH EVIDENCE _____ Use the passage

1 What is the team's specific design problem?

2 List two measurable criteria the litter catcher must meet.

3 Name two constraints that limit the team's design choices.

4 What trade-off does the mesh opening create, and what environmental effect must the team consider?

3 YOUR TURN _____ Your own words

A bus stop gets very hot in summer. In 70 to 100 words, write a design brief for a shade structure. State the problem, give two measurable criteria and two constraints, and explain one scientific principle plus one possible impact on people or the natural environment.

PART 1 • READ AND MARK

Underline each measurable criterion, circle each constraint, and number the statements that describe a scientific principle or a possible impact on people or the environment. Accept any marking that follows this job and points at the right text.

PART 2 • ANSWERS

#	QUESTION	ANSWER
1	What is the team's specific design problem?	Create a removable litter catcher for the drain that keeps litter out of Pine Creek without blocking rainwater or making the courtyard unsafe during storms.
2	List two measurable criteria the litter catcher must meet.	Any two: trap at least 80 percent of test litter, allow water to drain after a 15-minute spray test, or be removable by one adult in under two minutes.
3	Name two constraints that limit the team's design choices.	Any two: a budget of no more than \$120, no drilling into the old concrete rim, or fitting inside a 30-centimeter-wide opening.
4	What trade-off does the mesh opening create, and what environmental effect must the team consider?	Smaller mesh holes catch more debris but can slow water flow. The catcher could trap small animals, and rusting materials could send pieces downstream.

PART 3 • YOUR TURN (SAMPLE ANSWER)

The problem is to design a bus-stop shade that lowers the waiting area's temperature. It must shade a bench for at least four people from noon to 3 p.m. and reduce the bench-surface temperature by 10°C compared with an unshaded bench on a sunny day. It may cost no more than \$900 and cannot block the sidewalk. Because dark surfaces absorb more solar energy, I would use a light-colored roof. The shade could prevent heat stress for riders, but its posts should avoid damaging nearby tree roots.

Accept equivalent wording for the passage answers when it identifies the stated criteria, constraints, trade-off, and impact. For the open response, accept reasonable designs that include a precise problem, two measurable criteria, two limits, a relevant scientific principle, and an impact.