FIRST LIGHT ACADEMY

HELIOS PROVING GROUNDS

State of the Arc

Battle school companion

Arc smarter, not harder.

Turn projectile calculations into shared volleys, movement, crater recovery and carrier operations. Work alongside the six optional battle-school drills.

CADET _____ CLASS _____

INSTRUCTOR _____ DATE _____

Six drills / seven activity pages / two questions per worksheet page. Keep first Solve entries visible; put observations and corrections underneath.

Print on Letter paper, portrait, at actual size. Use this companion after the Academy field manual (SOA-FM-01). You may skip or revisit any drill.

HOW TO PLAY / BATTLE SCHOOL

From plan to debrief

1 / Open a drill

Enter academy → Start battle school. Choose a drill opens any of the six lessons. The drills use Academy gravity, $g = 2.0\ m/s^2$, and authored starting conditions.

2 / Keep a first prediction

Work across Givens, Unknowns, Equation, Substitute and Solve. Solve is your prediction. For a rule question, state the relevant rule under Equation and apply it under Substitute.

3 / Lock the private plans

Set the listed artillery and support orders. Lock Player A’s orders, hand over the device, then let B plan and lock. In drills 2-6 the declared coach order supplies B’s plan.

4 / Watch the shared clock

Select Watch turn play out. Any number of cannons may move and hold fire. The rest share the firing solution. Steep slopes trigger the winch automatically. Use Pause, Resume or Finish turn; playback speed changes viewing time, not projectile physics.

5 / Compare before correcting

Read impact x, flight time and movement in the debrief. Keep your original Solve result and label corrections. Retry trial restores the comparison setup. Skip tutorial never adds completion.

Activity	Battle-school drill	Page
B01 / Shared volleys	1 / Private plans	4
B02 / Movement	2 / Move some	5
B03 / Recovery	3 / Automatic winch	6
B04 / Obstruction	4 / Shot stopped early	7
B05 / Counterattack	5 / Unlock a counterattack	8
B06-B07 / Carrier cycle	6 / Deploy. Drop. Return.	9-10

Paper / observation records your choice to work on paper; it does not save or grade that written answer. Normal matches use separate saves. Reloading a drill restarts it while keeping its recorded first entries.

REFERENCE DESK / BEFORE YOU FIRE

Two components. One clock.

Use SI units, +x right and +y up. Gravity g is a positive magnitude, so $a_y = -g$. Measure coordinates from one datum. A muzzle is above the chassis; payload height is above the actual contact surface.

World	Moon	Academy	Mars	Earth
g (m/s^2)	1.6	2.0	3.7	9.8

$v_x = \pm v \cos\theta$ / $v_{y0} = v \sin\theta$

Use degrees. Choose the horizontal sign from the firing direction.

$\Delta y = v_{y0}t - \frac{1}{2}gt^2$ / $x = x_0 + v_x t$

Solve the vertical equation, then use the same positive time horizontally.

Horizontal drop: $t = \sqrt{(2h/g)}$ / $\Delta x = v_x t$

Here $h = y_0 - y_{contact}$. Carrier travel before release is not payload flight time.

$\Delta x = x_{final} - x_{initial}$

A surface route over a slope can be longer than its horizontal displacement.

Worked paper example / different numbers from the drills

Givens	**U**nknowns	**E**quation	**S**ubstitute	**S**olve
h = 9 m g = 2 m/s^2 $v_{y0} = 0$	Fall time t	$t = \sqrt{(2h/g)}$	$t = \sqrt{[(2 \times 9\ m) / (2\ m/s^2)]}$	t = 3 s Positive root.

An ideal answer has assumptions

A flat-plane calculation assumes nothing intercepts the flight before that plane. A crater wall, another unit or changing ground can produce an earlier or later contact. Explain the geometry before changing gravity or calling a difference an arithmetic error.

Enter about 0.1 s and 1 m precision for flight predictions; keep extra digits in calculations. The input is absolute impact x, not distance Δx. On the worksheets, observed results go below the work tables.

B01 / BATTLE-SCHOOL WORK AREA

Private plans. Shared volleys.

Open: 1 / Private plans. Shared volleys.

Academy g = 2.0 m/s^2. Fire at 20 m/s and 30°. A fires right; B fires left. Ground y = 30 m. Reference muzzles: A1 (1259.526, 47.500) m; B3 (2590.474, 47.500) m.

Keep all cannons stationary and hold defensive fire. Enter the Solve results as impact x and flight time for each player, then lock A, hand over and lock B.

1 / Find the flight time from either reference muzzle to the flat ground.

Givens	**U**nknowns	**E**quation	**S**ubstitute	**S**olve

2 / Find the impact x for A1 and B3. Show the sign of each horizontal velocity.

Givens	**U**nknowns	**E**quation	**S**ubstitute	**S**olve

Observed reference results: A1 x _____ m, t _____ s; B3 x _____ m, t _____ s.

Explain: Why do cannons sharing one speed and angle land at different x coordinates?

B02 / BATTLE-SCHOOL WORK AREA

Move some. Fire the rest.

Open: 2 / Move some. Fire the rest.

A1 begins at x = 1250 m; A5 at x = 1000 m. Both move 40 m Right (+x) on flat ground. A2 stays at x = 1400 m; its muzzle is (1409.526, 47.500) m. Use 20 m/s, 30°, g = 2.0 m/s^2 and ground y = 30 m.

Open Cannon movement. Set A1 and A5 to Move, 40 m, Right (+x); leave A2 on Fire. Use paper / observation. A2 becomes the reference; hold defensive fire.

1 / Predict the final x of A1 and A5. Identify which A cannon fires.

Givens	**U**nknowns	**E**quation	**S**ubstitute	**S**olve

2 / Predict A2's flight time and impact x. Use its muzzle, not its chassis position.

Givens	**U**nknowns	**E**quation	**S**ubstitute	**S**olve

Observed: A1 final x ____ m; A5 final x ____ m; A2 impact x ____ m, t ____ s.

Explain: How does movement change which cannon you should use as the reference?

B03 / BATTLE-SCHOOL WORK AREA

Automatic winch.

Open: 3 / Automatic winch. / two trials

A1 begins at x = 1250 m. Trial 1 uses flat ground; trial 2 starts inside a crater. In both trials, request Move, 80 m, Right (+x). Keep A2 on Fire at 20 m/s and 30°. Movement has a 10 s window.

Open Cannon movement and set A1's order. Use paper / observation and hold defensive fire. Resolve trial 1, then select Repeat on steep ground. The winch engages automatically on steep slopes.

1 / Predict A1's final x on flat ground. Does it need the winch?

Givens	**U**nknowns	**E**quation	**S**ubstitute	**S**olve

2 / Predict whether the crater route will be shorter in the same time. Should surface distance equal horizontal displacement?

Givens	**U**nknowns	**E**quation	**S**ubstitute	**S**olve

Flat: distance ____ m; final x ____ m. Crater: distance ____ m; final x ____ m.

Explain: Use $\Delta x = x_{final}$ - 1250 m. Explain why the same Move order has different results.

B04 / BATTLE-SCHOOL WORK AREA

Why did the shot stop early?

Open: 4 / Why did the shot stop early?

A1 fires right at 20 m/s and 10° with g = 2.0 m/s^2. Muzzle: (1260.833, -26.090) m. First assume a horizontal landing plane at y = -40 m. The actual crater has a rising wall.

Keep A1 as reference, order no movement and hold defensive fire. Enter both flat-plane Solve results. Watch the actual shot, then check the explanation in the game.

1 / Find the ideal flight time to y = -40 m if that flat plane continued.

Givens	**U**nknowns	**E**quation	**S**ubstitute	**S**olve

2 / Find the corresponding ideal impact x. Keep this first answer visible when the actual shot stops.

Givens	**U**nknowns	**E**quation	**S**ubstitute	**S**olve

Actual A1 impact: x _____ m; t _____ s. Assumed landing y: -40 m.

Explain: Which assumption failed: constant gravity, clear space above a flat landing plane, or degree mode?

B05 / BATTLE-SCHOOL WORK AREA

Unlock a counterattack.

Open: 5 / Unlock a counterattack. / two trials

Normal bases start with 5 HP. This drill starts base A at 3 HP with no nuclear round. One round is unlocked once per match when the surviving base reaches 2 HP or less. The incoming practice shell removes 1 HP.

Trial 1: keep mobile artillery at 20 m/s and 30°, with no movement or support fire. Trial 2: select Launch one nuclear round, 30 m/s, 45°, Right (+x). Keep paper / observation selected.

1 / Find base A’s HP after the hit. Can it use the newly unlocked round during that same turn?

Givens	**U**nknowns	**E**quation	**S**ubstitute	**S**olve

2 / The next turn begins with one nuclear round. After firing it, how many remain? State who can be damaged within its 200 m blast radius.

Givens	**U**nknowns	**E**quation	**S**ubstitute	**S**olve

Observed: base HP ____; ammunition before firing ____; after firing ____.

Explain: Why must you inspect nearby friendly objects before using the counterattack?

B06 / BATTLE-SCHOOL WORK AREA

Deploy, then drop ordnance.

Open: 6 / Deploy. Drop. Return. / rounds 1 and 2

Use g = 2.0 m/s^2, payload y_0 = 130 m, v_x = +16 m/s and v_{y0} = 0. For both predictions, assume contact at y = 30 m. A releases at x = 902 m in round 1 and x = 2360 m in round 2.

Start drill 6 fresh with four artillery per team. Use 20 m/s, 10°, no movement/support fire, and Scheduled payload. Keep paper / observation: the orders' prediction inputs refer to an artillery shell.

1 / For round 1, find payload flight time, horizontal travel and first-contact x.

Givens	**U**nknowns	**E**quation	**S**ubstitute	**S**olve

2 / For round 2, predict ordnance flight time and impact x using the same flat-plane assumption.

Givens	**U**nknowns	**E**quation	**S**ubstitute	**S**olve

Carrier reports: round 1 x ____ m, t ____ s; round 2 x ____ m, t ____ s.

Explain: Distinguish first contact from a cannon's later skid. Could newly excavated ground change the second drop?

B07 / BATTLE-SCHOOL WORK AREA

Return, refuel, repeat.

Open: 6 / Deploy. Drop. Return. / rounds 3 and 4

Continue the carrier drill without restarting it. The repeating schedule is deployment, ordnance, then home-pad service. This training field has a maximum of five active artillery per team. Normal maps start 1 / 2 / 3 cannons on Small / Medium / Large; their caps are 3 / 5 / 5.

Keep the prescribed 20 m/s and 10° artillery settings. On round 3, watch the landing pad. On round 4, keep Scheduled payload. Pause or Finish turn if needed; playback speed does not change the physics.

1 / Predict round 3’s task, destination and whether a payload should be released.

Givens	**U**nknowns	**E**quation	**S**ubstitute	**S**olve

2 / With five active cannons, predict round 4’s payload action. What tasks follow in rounds 5 and 6?

Givens	**U**nknowns	**E**quation	**S**ubstitute	**S**olve

Observed: round 3 carrier status _____; round 4 active cannons ____; payload _____.

Explain: Why does holding a reinforcement at the cap leave the three-round schedule unchanged?

REUSABLE WORK AREA / MAKE EXTRA COPIES

Keep the reasoning. Revise the plan.

Use one table for a fresh prediction and one for a later trial or correction. Record the drill, world and units. Do not erase the first Solve result.

1 / Drill _____ World _____ Quantity / decision _____

Givens	**U**nknowns	**E**quation	**S**ubstitute	**S**olve

Observed result / reason for revision: _____

2 / Drill _____ World _____ Quantity / decision _____

Givens	**U**nknowns	**E**quation	**S**ubstitute	**S**olve

Observed result / reason for revision: _____

Check the reference cannon, muzzle height, signed velocity, assumed contact plane and actual terrain. For carriers, separate travel to release, payload flight and the final bounce or skid.