NOVEMBER 2026 / JANUARY 2027 PLANNING

Novel stimulus practice

Six original stimuli per course. Original constructed data, narratives and historical teaching simulations.

Course	Pages
Algebra I	2-7
Geometry	8-13
Algebra II	14-19
English Language Arts	20-25
Global History and Geography II	26-31
U.S. History and Government	32-37
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Physical Science: Chemistry	50-55
Physical Science: Physics	56-61
Physical Setting/Chemistry	62-67
Physical Setting/Physics	68-73

The course list and PDF bookmarks navigate to each atlas. Source links open the original public materials.

Charging the battery cart

Linear models | cost comparison

Name _____ Date _____

A school rents a portable battery cart. Plan A costs $18 plus $4 per hour. Plan B costs $7 per hour. Rental time is recorded in whole hours.

1. Write both cost functions and find their intersection.

2. For which allowed hours is A strictly cheaper? Justify the boundary.

3. A student says A is cheaper at six hours. Evaluate the claim.

Use evidence and show the relationships in your reasoning. Additional paper is permitted.

Raised garden arch

Quadratic structure | equation and interval

Name _____ Date _____

A decorative arch is modeled by h(x)=-x^2+10x feet above a walkway. x is horizontal distance from one ground contact.

1. Find both ground contacts and the maximum height.

2. Find where the arch is at least 16 feet high. Show how the inequality relates to the roots.

3. State a physically meaningful domain.

Use evidence and show the relationships in your reasoning. Additional paper is permitted.

Two receipt checks

Systems and constraints | paired receipts

Name _____ Date _____

Receipt A lists 2 sandwiches and 3 drinks for $25. Receipt B lists 4 sandwiches and 1 drink for $35. Prices are the same on both receipts.

1. Test the proposed prices $8 per sandwich and $3 per drink against both receipts.

2. Solve for the prices and verify both receipts.

3. Explain why a single matching receipt is insufficient.

Use evidence and show the relationships in your reasoning. Additional paper is permitted.

Same center, different repair times

Statistics | two distributions

Name _____ Date _____

Two repair teams record completion times in minutes for five identical routine jobs.

Job	A	B
1	8	1
2	9	9
3	10	10
4	11	11
5	12	19

1. Compute the mean and median for each team.

2. Compare spread using the range and describe a limitation of the comparison.

3. Choose a team if predictable completion is the only criterion, and support your choice.

Use evidence and show the relationships in your reasoning. Additional paper is permitted.

Labels on an exponential model

Growth and functions | model comparison

Name _____ Date _____

A tank model gives C(t)=80(0.75)^t milligrams of dissolved material after t whole filtration cycles. A second model gives D(t)=80-20t.

1. Interpret 80 and 0.75 in C.

2. Compare the models at t=1 and t=2.

3. Explain why D becomes unreasonable after enough cycles.

Use evidence and show the relationships in your reasoning. Additional paper is permitted.

Measuring foam panels

Quantities and precision | unit conversion

Name _____ Date _____

A shop buys foam at $6 per square meter. One rectangular panel measures 120 cm by 50 cm. An order requires 20 panels, with no waste allowance.

1. Convert the dimensions to meters and find one panel area.

2. Find the material cost for the order.

3. Explain the error in multiplying 120 by 50 and treating the result as square meters.

Use evidence and show the relationships in your reasoning. Additional paper is permitted.

Classifying a loading bay

Coordinate proof | coordinates

Name _____ Date _____

A loading bay has vertices A(0,0), B(6,0), C(8,4), D(2,4), in that order.

1. Use slopes to prove a parallelogram.

2. Decide whether it is a rectangle using an independent calculation.

3. Decide whether it is a rhombus. State the condition tested.

Use evidence and show the relationships in your reasoning. Additional paper is permitted.

One observation cannot prove congruence

Congruence and argument | counterexample

Name _____ Date _____

Two triangles each have a pair of sides of lengths 5 and 7. Their included angles measure 40 degrees and 70 degrees.

1. Does the supplied information prove congruence? Explain.

2. State a change that would make SAS applicable.

3. Describe a rigid-motion property supporting the conclusion.

Use evidence and show the relationships in your reasoning. Additional paper is permitted.

Two similar ramps

Similarity and trigonometry | scaled right triangles

Name _____ Date _____

Ramp A rises 0.6 m over a horizontal run of 4.8 m. Ramp B is similar and rises 0.9 m.

1. Find B's horizontal run.

2. Find the incline angle of A to the nearest degree.

3. Explain whether similarity alone guarantees either ramp meets an unspecified access rule.

Use evidence and show the relationships in your reasoning. Additional paper is permitted.

Sector signs

Circles and measurement | arc and area

Name _____ Date _____

Two circular signs use 60-degree sectors. Their radii are 3 cm and 9 cm.

1. Compute both arc lengths exactly.

2. Compute both sector areas exactly.

3. Explain the different scale factors.

Use evidence and show the relationships in your reasoning. Additional paper is permitted.

An open cylinder

Volume and modeling | container decision

Name _____ Date _____

Two open-top cylinders have (radius,height) values (3,8) cm and (4,4.5) cm. Ignore thickness. Material area is pi*r^2+2*pi*r*h.

1. Show that the capacities match.

2. Compare the material areas.

3. State one modeling assumption that could change a practical choice.

Use evidence and show the relationships in your reasoning. Additional paper is permitted.

Which transformations undo each other?

Transformations | coordinate rule

Name _____ Date _____

Apply T(x,y)=(x+4,y-2), then reflect across the x-axis.

1. Write the composite coordinate rule.

2. Apply it to P(-1,3).

3. Compare with reversing the order and explain whether order matters.

Use evidence and show the relationships in your reasoning. Additional paper is permitted.

ALGEBRA II / ALG2-N01

A changing coolant temperature

Exponential and logarithmic models | threshold model

Name _____ Date _____

A constructed coolant model is T(t)=20+80(0.8)^t degrees Celsius after t whole minutes.

1. Explain the initial temperature and long-run level.

2. Find the first recorded minute at which T is below 50.

3. Explain why solving for a continuous threshold is only part of the answer.

Use evidence and show the relationships in your reasoning. Additional paper is permitted.

A platform that repeats

Periodic functions | sinusoidal model

Name _____ Date _____

A platform height is h(t)=7+3 sin(pi*t/6) meters, with t in seconds.

1. Find amplitude, midline and period.

2. Find the first positive time of maximum height.

3. Explain the difference between the pi/6 parameter and cycles per second.

Use evidence and show the relationships in your reasoning. Additional paper is permitted.

Exactly one inspection failure

Probability | event comparison

Name _____ Date _____

Two independent machines each have probability 0.2 of failing an inspection on a given day. Let F1 and F2 identify failures.

1. Find the probability that exactly one fails.

2. Find the probability that at least one fails.

3. State why the answers differ and identify the assumption enabling multiplication.

Use evidence and show the relationships in your reasoning. Additional paper is permitted.

ALGEBRA II / ALG2-N04

A randomized tutoring comparison

Inference and study design | simulation result

Name _____ Date _____

Forty volunteers are randomly assigned equally to two tutoring methods. The observed difference in mean improvement is +3 points for A minus B. A randomization model shuffles labels 200 times. Eight simulated differences are at least as extreme in absolute value as the observed difference.

1. Estimate the two-sided simulation tail proportion.

2. Explain what the random assignment supports.

3. Name a generalization limitation and explain why the simulation does not prove A helps every student.

Use evidence and show the relationships in your reasoning. Additional paper is permitted.

A canceled factor

Rational expressions | domain and equivalence

Name _____ Date _____

A student simplifies f(x)=(x^2-9)/(x-3) to g(x)=x+3.

1. State the domain restriction on f.

2. Evaluate both expressions at x=2 and discuss x=3.

3. Explain precisely where the formulas agree.

Use evidence and show the relationships in your reasoning. Additional paper is permitted.

A mean that hides a mixture

Distribution and model choice | two subgroup summaries

Name _____ Date _____

A service center has equal numbers of express jobs averaging 10 minutes and specialist jobs averaging 50 minutes. Each subgroup has little variation around its own mean.

1. Find the combined mean.

2. Explain why a single narrow normal model centered there could misrepresent the data.

3. Identify useful information for predicting an individual job duration.

Use evidence and show the relationships in your reasoning. Additional paper is permitted.

The repaired radio

Fiction and character | original narrative

Name _____ Date _____

Mara had promised that the old radio would play before her father returned. By dusk, screws lay across the kitchen towel like pieces of a map she could no longer read. When his key turned, she slid the towel beneath a newspaper. He set his bag beside it and asked whether the evening news had begun. Mara reached for her phone. Her father lifted the paper, looked at the open case, and pulled a chair to the table. He placed one screw on the wood between them. "Where did this one go?" he asked. She moved the phone aside.

1. Infer how Mara's expectation of her father changes.

2. Analyze how one action at the end develops that change.

3. Explain an alternative reading that the text leaves open.

Use evidence and show the relationships in your reasoning. Additional paper is permitted.

First thaw

Poetry and figurative language | original poem

Name _____ Date _____

Under the loading dock
the last ice keeps its ledger.
Boots cross the morning gravel.
Water adds a quiet line.
I bring the shovel out,
then leave it by the door.
What held the yard all winter
is loosening without me.

1. Develop a defensible central idea using two details.

2. Analyze the effect of describing ice as keeping a ledger.

3. Explain how the final two lines complicate the speaker's role.

Use evidence and show the relationships in your reasoning. Additional paper is permitted.

Who counts as a reader?

Rhetoric and perspective | original editorial

Name _____ Date _____

Our library counts every book that crosses its desk. It cannot count the page a reader returns to after a difficult day. A circulation total tells us something useful, but it should not become our definition of reading. Before we reduce the quiet room to make space for more checkout stations, ask the people who stay there. The busiest place is not always the place doing the most visible work.

1. Identify the writer's position on the proposed change.

2. Explain the effect of contrasting countable activity with private reading.

3. Identify evidence the argument would need to compare the proposed uses of space.

Use evidence and show the relationships in your reasoning. Additional paper is permitted.

Should the lab remain open after school?

Source-based argument | constructed argument source set

Name _____ Date _____

Source A, student survey: 60 of 100 respondents would attend a later lab at least once a week. Only 100 of 400 students responded. Source B, attendance log: current sessions average 18 students for 24 seats. Source C, staffing note: one later session costs $160 and requires a trained supervisor. Source D, student statement: students with afternoon jobs prefer an early session. These four sources are constructed for argument practice.

1. Make a qualified recommendation using at least three sources.

2. Address a competing need with evidence.

3. Identify one limitation that should shape the recommendation.

Use evidence and show the relationships in your reasoning. Additional paper is permitted.

The title changes the reading

Structure and ambiguity | original microfiction

Name _____ Date _____

Title: Inventory. At closing, Leon counted six chairs, three lamps, and one cracked bowl. The shop would open under a different name on Monday. He wrote each item on the form, then added the pencil he had been holding all evening. There was no line for the sound his mother made when the bell above the door rang.

1. Explain a possible relationship between the title and the final sentence.

2. Trace how the list structure develops meaning.

3. Support a second possible interpretation without inventing information.

Use evidence and show the relationships in your reasoning. Additional paper is permitted.

A chart needs a sentence

Evidence and information | constructed data and competing claims

Name _____ Date _____

A school pilots a tool-lending shelf. Each month has 100 eligible borrowers. The records below count loans and late returns. Student A argues participation grew. Student B argues reliability worsened.

Month	Loans	Late returns
1	20	4
2	40	6

1. Evaluate A's claim using the appropriate comparison.

2. Evaluate B's claim using both counts and rates.

3. Write a two-sentence conclusion that distinguishes the two outcomes.

Use evidence and show the relationships in your reasoning. Additional paper is permitted.

Rights on paper and in practice

Revolution and citizenship | historical teaching simulation

Name _____ Date _____

A constructed scenario set during the age of Atlantic revolutions. Document A, a reform petition, says public authority should protect equal civil rights. Document B, an eligibility notice, restricts voting to adult property owners. These invented documents illustrate a historical tension and are not quotations from actual people.

1. Explain a tension between the two documents.

2. Identify historical context relevant to the demand in A.

3. Identify one question an historian should ask before generalizing from the pair.

Use evidence and show the relationships in your reasoning. Additional paper is permitted.

Mechanization and the household

Industrialization | constructed household accounts

Name _____ Date _____

A fictional industrial town records the following household conditions before and after a mill opens. The two observations do not isolate a cause.

Measure	Before	After
Weekly cash income	6	10
Household farm hours	40	24
Paid mill workers	0	2

1. Describe one change using the data.

2. Explain a possible connection to industrialization.

3. State a limit on a causal claim and identify useful corroboration.

Use evidence and show the relationships in your reasoning. Additional paper is permitted.

The railway and the concession

Imperialism and perspective | constructed source pair

Name _____ Date _____

Classroom simulation of a colonial transport project. A company prospectus promises rapid shipment from an inland mine to a port. A local council petition describes loss of farmland along the route. No author or date is attributed to these invented documents.

1. Compare the priorities represented by the sources.

2. Explain how the transport route could serve an imperial economic relationship.

3. Evaluate the petition's usefulness for studying local effects, with a specific limitation.

Use evidence and show the relationships in your reasoning. Additional paper is permitted.

Peace after war

War and international institutions | constructed policy debate

Name _____ Date _____

Two invented postwar policy summaries are provided. A calls for an international body to mediate disputes before armed conflict. B says states must retain independent authority over military decisions. Both refer to the human and economic cost of a recent major war.

1. Explain a relationship between the war context and A's proposal.

2. Compare the policy priorities.

3. Use one verified example from the course to explain a challenge facing international cooperation.

Use evidence and show the relationships in your reasoning. Additional paper is permitted.

Winning independence, choosing priorities

Decolonization | constructed national planning debate

Name _____ Date _____

A fictional newly independent country considers two plans. Plan A expands export crops to earn foreign currency. Plan B shifts land toward food crops to reduce dependence on imported food. Both require scarce irrigation funds.

1. Explain the policy tension.

2. Contextualize one continuing economic challenge after independence.

3. Identify evidence needed to judge either plan's likely outcome.

Use evidence and show the relationships in your reasoning. Additional paper is permitted.

An issue across two settings

Human rights and enduring issues | constructed evidence set

Name _____ Date _____

Setting A, an invented early industrial city: workers petition for safe equipment after repeated injuries. Setting B, an invented contemporary export zone: workers seek enforcement of safety rules despite an existing law. These scenarios are teaching models. They supply evidence about the scenarios rather than proof of actual historical events.

1. Develop an enduring-issue claim supported by both settings.

2. Explain continuity and one difference.

3. Name the verified historical evidence needed to develop this into a Regents-style essay.

Use evidence and show the relationships in your reasoning. Additional paper is permitted.

A rule and a power

Constitutional foundations | constructed civic case

Name _____ Date _____

A fictional state blocks sale of products arriving from another state. A federal rule permits those products under national commerce policy. The task supplies the premises that the federal rule is constitutionally valid and the laws conflict.

1. Explain the relevant federalism issue.

2. Explain which rule controls under the supplied premises.

3. Distinguish applying the supplied premises from deciding independently that any federal action is valid.

Use evidence and show the relationships in your reasoning. Additional paper is permitted.

A promise and a barrier

Reconstruction and citizenship | constructed policy evidence

Name _____ Date _____

Two classroom summaries describe the Reconstruction era. A states that new constitutional protections expanded citizenship and voting protections. B describes violence and local obstruction aimed at restricting Black political participation. These are teaching summaries rather than quotations or complete historical sources.

1. Explain the relationship between legal change and the conditions in B.

2. Explain why the evidence challenges a claim that legal adoption alone guaranteed participation.

3. Identify a useful additional primary source and the question it could answer.

Use evidence and show the relationships in your reasoning. Additional paper is permitted.

Who benefits from a rate?

Industrialization and reform | constructed economic source pair

Name _____ Date _____

In a fictional 1890s shipping dispute, a large firm receives a lower freight rate per ton than small producers. The railroad argues that bulk contracts reduce its costs. Small producers petition for equal treatment. These invented statements are a model for source comparison.

1. Compare the economic interests.

2. Explain how the dispute could motivate demands for government regulation.

3. Evaluate the railroad statement's usefulness for a question about its own justification.

Use evidence and show the relationships in your reasoning. Additional paper is permitted.

Relief, recovery, reform

Depression and government | constructed program table

Name _____ Date _____

A classroom simulation describes three responses to a severe economic depression. A provides immediate food support. B pays workers to rebuild roads. C creates long-term rules for financial institutions.

1. Explain a difference in the purposes of the responses.

2. Analyze a relationship between the economic crisis and increased federal involvement.

3. Explain why a program's stated purpose is insufficient to determine its success.

Use evidence and show the relationships in your reasoning. Additional paper is permitted.

A message has an audience

Cold War and sourcing | constructed diplomatic source pair

Name _____ Date _____

A fictional public speech defends an overseas alliance as protection against ideological expansion. A confidential planning note from the same government discusses shipping access and a regional base. Both are invented for sourcing practice.

1. Explain a difference in emphasis and connect it to audience.

2. Evaluate the speech's reliability for studying the public case made for the alliance.

3. Explain what the pair can and cannot establish about motives.

Use evidence and show the relationships in your reasoning. Additional paper is permitted.

The turnout denominator

Civil rights and civic outcomes | constructed participation data

Name _____ Date _____

A fictional county changes voting procedures after an enforcement action. Eligible voters remain 1000 in both years. Registered voters and ballots cast are listed below. The data do not identify a comparison county.

Year	Registered	Ballots cast
Before	400	300
After	700	420

1. Calculate registration and turnout among eligible voters in both years.

2. Explain the difference between turnout among registered and among eligible voters.

3. Make a qualified claim about change and state a causal limit.

Use evidence and show the relationships in your reasoning. Additional paper is permitted.

A pond after a nutrient pulse

Ecosystem stability | constructed time series

Name _____ Date _____

A shallow pond receives a nutrient pulse on day 0. The table is a constructed teaching dataset. Dissolved oxygen is measured at dawn. Algae can photosynthesize in light; organisms also respire, and decomposers use oxygen when breaking down organic matter.

Day	Algae index	Dawn oxygen mg/L
0	10	8
4	80	3
8	25	4

1. Use the data to support a claim about ecosystem change.

2. Construct a causal explanation linking the bloom, decomposition and oxygen.

3. Identify one observation needed to test the explanation against an alternative.

Use evidence and show the relationships in your reasoning. Additional paper is permitted.

The resistant survivors

Natural selection | constructed population model

Name _____ Date _____

A population initially contains 90 susceptible insects and 10 resistant insects. After one application, 9 susceptible and 8 resistant insects survive. Resistance is inherited. Survivors reproduce. The treatment does not create the resistance allele in this model.

1. Calculate the resistant fraction before and immediately after treatment.

2. Explain how repeated selection could change a later generation.

3. Distinguish selection from a claim that individual insects changed because they needed resistance.

Use evidence and show the relationships in your reasoning. Additional paper is permitted.

Where does the dry mass come from?

Matter and energy | constructed growth investigation

Name _____ Date _____

Two similar seedlings receive equal minerals and water for a week. One grows in light with access to carbon dioxide; one remains dark. The light-grown plant gains dry mass. Students are told dry mass is measured after water is removed.

1. Develop a model for carbon entering the light-grown plant.

2. Explain how light and carbon dioxide play different roles in photosynthesis.

3. Identify a control or measurement that would strengthen the investigation.

Use evidence and show the relationships in your reasoning. Additional paper is permitted.

A response that reverses a change

Homeostasis | constructed feedback data

Name _____ Date _____

A simulation tracks a body regulation variable with a target of 5 units. A disturbance raises it to 8. A response activates, and readings return through 7 and 6 to 5. When the response is blocked under otherwise similar conditions, readings stay near 8.

1. Explain why this pattern supports negative feedback.

2. Design a repeated comparison to test whether the response contributes to recovery.

3. State a limitation of the simulation for explaining a real body system.

Use evidence and show the relationships in your reasoning. Additional paper is permitted.

A mutation and a chain of effects

Information and protein | constructed molecular model

Name _____ Date _____

A model gene encodes a protein that transports a nutrient into a cell. A mutation changes the protein's shape. In a controlled model system, altered proteins bind less nutrient; the cells grow more slowly. No DNA sequence or complete folding mechanism is supplied.

1. Construct an explanation linking DNA information, protein and cell function.

2. Identify evidence supporting the proposed pathway.

3. Identify a claim about the exact molecular change that the supplied model cannot establish.

Use evidence and show the relationships in your reasoning. Additional paper is permitted.

Restoring a migration route

Human impacts and solutions | constructed design decision

Name _____ Date _____

A stream barrier limits fish migration. A team compares two proposed designs using constructed pilot estimates. Budget ceiling is $60,000. A third option, removing the barrier, has not been evaluated.

Design	Cost $	Estimated passage
A	40000	55%
B	75000	80%

1. Evaluate both designs against ecological and budget criteria.

2. Recommend a plan or revision with a stated trade-off.

3. Design one post-installation measure to evaluate the ecological outcome.

Use evidence and show the relationships in your reasoning. Additional paper is permitted.

A roof and its energy budget

Climate and energy | constructed energy budget

Name _____ Date _____

At equal incoming sunlight of 800 W/m², Roof A reflects 200 W/m² and Roof B reflects 480 W/m². Treat all unreflected sunlight as absorbed in this simplified comparison. Actual urban temperatures also depend on heat transfer, storage and surrounding surfaces.

1. Calculate reflected fractions and absorbed solar energy per square meter.

2. Explain a mechanism by which the roof choice could affect local heating.

3. Explain a limitation on using this model to predict a city-wide temperature change.

Use evidence and show the relationships in your reasoning. Additional paper is permitted.

The afternoon shore breeze

Weather and circulation | constructed temperature transect

Name _____ Date _____

On a sunny afternoon, a shoreline station records land surface at 32°C and adjacent water at 20°C. The initial air over the warmer surface heats, becomes less dense relative to surrounding air, and rises. Use the same initial air pressure at the start of the model.

1. Draw a circulation model with surface and upper-level arrows.

2. Explain how unequal heating contributes to the modeled surface flow.

3. Identify an observation that would challenge the proposed circulation.

Use evidence and show the relationships in your reasoning. Additional paper is permitted.

A moving plate, a time pattern

Plate tectonics | constructed island-age model

Name _____ Date _____

A simplified chain of volcanic islands lies on a plate moving over a relatively fixed hot spot. Island X is active at position 0 km. Y is 200 km away and 2 million years old. Z is 500 km away and 5 million years old.

1. Estimate the modeled plate speed in centimeters per year.

2. Explain the relationship among distance, age and active volcanism.

3. State an assumption and identify evidence that could weaken the model.

Use evidence and show the relationships in your reasoning. Additional paper is permitted.

Water through a sediment column

Water and Earth materials | constructed investigation design

Name _____ Date _____

Two sediment columns have equal height and diameter. A contains coarse sand and B fine sediment. Each receives 100 mL of water at the top. After ten minutes, A has released 80 mL and B 30 mL from the bottom. Assume no evaporation and no water remaining above the sediment.

1. Design a repeated comparison to test the effect of grain size.

2. Use the supplied evidence to compare drainage and retained water.

3. Explain a water-material mechanism and name an additional property that should be measured.

Use evidence and show the relationships in your reasoning. Additional paper is permitted.

A repeated dimming

Orbital evidence | constructed light-curve data

Name _____ Date _____

A star's relative brightness dips at days 2, 8 and 14, each with similar depth and duration. A simple model attributes each dip to the same orbiting object passing in front of the star from the observer's viewpoint.

1. Infer the modeled orbital period.

2. Explain what the repeat pattern supports and what a single dip could not establish.

3. Identify an alternative explanation or additional observation needed before a stronger conclusion.

Use evidence and show the relationships in your reasoning. Additional paper is permitted.

Recycling under constraints

Resources and decisions | constructed resource comparison

Name _____ Date _____

A town compares two metal-recycling systems over the same project term using constructed estimates. Plan A costs $2 million and recovers 1200 tonnes. Plan B costs $3 million and recovers 1600 tonnes. The budget is $2.5 million. Estimates include total project cost and metal recovered over that term. Ecological effects remain unmeasured.

1. Compare cost per recovered tonne and budget feasibility.

2. Recommend a plan or revision with a limitation.

3. Identify additional resource and environmental evidence required for a robust decision.

Use evidence and show the relationships in your reasoning. Additional paper is permitted.

The order on the periodic table

Atomic structure and properties | constructed element comparison

Name _____ Date _____

Model element X has valence pattern 2-8-1 and model element Y has 2-8-7. Treat them as neutral atoms in their ground states. The patterns are deliberately simplified shell representations.

1. Predict the common ion charge for each in an ionic compound.

2. Construct a model of electron transfer and the resulting ratio.

3. Explain what the shell model supports and one feature it leaves out.

Use evidence and show the relationships in your reasoning. Additional paper is permitted.

What the boiling evidence can show

Interparticle forces | constructed property investigation

Name _____ Date _____

Two molecular liquids of similar molar mass have boiling points 55°C and 95°C under the same external pressure. The task supplies that their main relevant difference is the strength of attractions between molecules.

1. Use the evidence to compare interparticle attractions.

2. Explain what energy supplied during boiling does in this model.

3. Design an additional measurement or control needed for a stronger comparison.

Use evidence and show the relationships in your reasoning. Additional paper is permitted.

Conservation on both sides

Reaction models | atom-count model

Name _____ Date _____

A proposed reaction is H2 + O2 -> H2O. The subscripts identify the substances and must remain fixed. The system is closed.

1. Balance the equation using coefficients.

2. Use atom counts to justify the coefficients.

3. Explain why a balanced equation supports mass conservation without requiring equal molecule counts.

Use evidence and show the relationships in your reasoning. Additional paper is permitted.

A system that warms its surroundings

Chemical energy | constructed thermal evidence

Name _____ Date _____

Two solutions are mixed in an insulated cup. The surrounding solution temperature rises from 21°C to 27°C. In a simplified energy model, the reaction system transfers energy to the solution. Assume other heat exchanges are negligible.

1. Identify the transfer direction and classify the modeled reaction.

2. Represent relative reactant and product chemical potential energy levels.

3. Explain why a temperature increase alone does not determine the activation energy.

Use evidence and show the relationships in your reasoning. Additional paper is permitted.

Which evidence measures rate?

Reaction rate | constructed reaction data

Name _____ Date _____

Equal masses of the same solid react with excess acid under two conditions. Gas volume is measured over time. Temperature is the only changed condition.

Time s	A mL	B mL
0	0	0
10	20	35
60	60	60

1. Compare the initial observed rates over 0 to 10 seconds.

2. Explain the comparison using a particle-collision model.

3. Explain why equal final volumes do not imply equal rates.

Use evidence and show the relationships in your reasoning. Additional paper is permitted.

A concentration threshold

Solutions | constructed solution data

Name _____ Date _____

A lab target permits at most 5 g of dissolved solute per 100 mL of solution. Sample A contains 12 g in 200 mL of solution. Sample B contains 9 g in 300 mL of solution. Volumes refer to final solution volumes.

1. Compare each sample with the target using a common basis.

2. Find the minimum final volume needed for A at the target concentration, retaining all solute.

3. Explain why volume of water added is not always identical to final solution volume.

Use evidence and show the relationships in your reasoning. Additional paper is permitted.

A cart with competing forces

Forces and motion | constructed motion data

Name _____ Date _____

A 4 kg cart has a 20 N force east and an 8 N force west. Neglect other horizontal forces and treat mass as constant.

1. Represent the forces and find net force and acceleration.

2. Explain why a westward force does not by itself establish westward motion.

3. Describe a measurement that could test the predicted acceleration.

Use evidence and show the relationships in your reasoning. Additional paper is permitted.

A landing pad that spreads a stop

Momentum and design | constructed force-time models

Name _____ Date _____

A falling test object lands on two pads. Pad A produces an idealized triangular force-time pulse with base 0.04 s and peak 800 N. Pad B produces a triangular pulse with base 0.08 s and peak 400 N. Treat the curves as net stopping force for this model.

1. Compare impulses using the areas.

2. Choose a pad if reducing peak force is the design criterion, and justify the role of time.

3. State a condition needed before applying the comparison to another object.

Use evidence and show the relationships in your reasoning. Additional paper is permitted.

Energy before the gate

Energy accounting | constructed energy budget

Name _____ Date _____

A cart starts with 120 J of mechanical energy. During travel, 30 J transfers to thermal energy through friction. At a lower gate its gravitational potential energy is 20 J. Account for the cart-track system and surroundings as specified.

1. Find kinetic energy at the gate.

2. Explain where the 30 J belongs in the energy account.

3. Describe how the prediction changes if frictional transfer doubles with the same initial state.

Use evidence and show the relationships in your reasoning. Additional paper is permitted.

Two lamps on a supply

Electrical energy | constructed circuit

Name _____ Date _____

Two ideal resistors, 6 ohms and 3 ohms, are connected in parallel to a 12 V ideal supply. Ignore wire resistance.

1. Calculate each branch current and total current.

2. Calculate the total power and energy delivered in 10 seconds.

3. Explain what happens to the first branch current if the second branch is removed under the ideal-source assumption.

Use evidence and show the relationships in your reasoning. Additional paper is permitted.

A wave crosses a boundary

Waves | constructed wave data

Name _____ Date _____

A repeating source makes waves at 5 Hz. In medium A their speed is 20 m/s. In medium B their speed is 10 m/s. The source frequency stays fixed at the boundary.

1. Find wavelength in each medium.

2. Explain which property is held constant and how the model links the other two.

3. Identify a measurement that would test the prediction.

Use evidence and show the relationships in your reasoning. Additional paper is permitted.

Two nuclear representations

Nuclear processes | constructed particle model

Name _____ Date _____

Model A shows one heavy nucleus splitting into two lighter nuclei and free neutrons. Model B shows two light nuclei combining into a heavier nucleus. In each case, the total rest mass of final products is slightly lower, and the mass-energy difference is released.

1. Distinguish the processes.

2. Explain the energy release with a conservation account.

3. Identify a quantity that must balance when writing a particular nuclear equation.

Use evidence and show the relationships in your reasoning. Additional paper is permitted.

Isotopes in a sample

Atomic identity | constructed isotope data

Name _____ Date _____

A sample contains 75% atoms of isotope X-20 and 25% of X-22. Both isotopes have atomic number 10. Use the stated mass numbers as approximate atomic masses.

1. Find the weighted average atomic mass.

2. State protons and neutrons for each isotope.

3. Explain what changes and what remains fixed between the isotopes.

Use evidence and show the relationships in your reasoning. Additional paper is permitted.

Count the electrons

Oxidation and reduction | half-reaction model

Name _____ Date _____

A proposed half-reaction is Mg -> Mg2+ + electrons. The atom begins electrically neutral.

1. Complete the half-reaction.

2. Classify the process as oxidation or reduction and justify.

3. Explain why charge balance requires that electron count.

Use evidence and show the relationships in your reasoning. Additional paper is permitted.

A gas model has a condition

Gas relationships | constructed gas data

Name _____ Date _____

A fixed amount of gas occupies 2.0 L at 300 K. Pressure stays constant as it warms to 450 K. Treat the gas as ideal for this model.

1. Calculate the final volume.

2. Explain the temperature unit needed for the proportional relationship.

3. State how the conclusion would change if amount or pressure were not held constant.

Use evidence and show the relationships in your reasoning. Additional paper is permitted.

The amount still dissolving

Dynamic equilibrium | constructed rate table

Name _____ Date _____

A closed system can undergo a forward and reverse reaction. Amounts stabilize after 30 seconds. The constructed rates at later times are each 4 particles per second in opposite directions.

1. Explain why stable amounts can coexist with continuing reactions.

2. State the rate relationship at dynamic equilibrium.

3. Explain why equal rates do not require equal amounts of reactants and products.

Use evidence and show the relationships in your reasoning. Additional paper is permitted.

A dilution with a final volume

Solutions and quantities | constructed preparation

Name _____ Date _____

A student takes 25 mL of 2.0 mol/L solution and dilutes it to a final solution volume of 100 mL. No solute reacts or escapes.

1. Find the initial amount of solute in moles.

2. Calculate the final concentration.

3. Explain why the calculation uses final solution volume.

Use evidence and show the relationships in your reasoning. Additional paper is permitted.

Heat in an insulated cup

Energy transfer | constructed calorimetry

Name _____ Date _____

A 50 g water sample warms from 20°C to 26°C. Use c=4.18 J/(g°C). Assume the only relevant transfer is from a hot metal sample to the water, and neglect the cup.

1. Calculate energy gained by water.

2. State the modeled energy change of the metal.

3. Identify a neglected transfer that could affect a real result.

Use evidence and show the relationships in your reasoning. Additional paper is permitted.

A spring with two energy routes

Mechanical energy | constructed spring data

Name _____ Date _____

A spring has k=200 N/m and is stretched 0.10 m within its elastic range. Its force increases linearly from zero to 20 N.

1. Calculate elastic potential energy using k and extension.

2. Verify with the area under the force-extension graph.

3. Explain why multiplying final force by the full extension overestimates the work.

Use evidence and show the relationships in your reasoning. Additional paper is permitted.

A circuit with a carried result

Electrical energy | constructed series circuit

Name _____ Date _____

An ideal 12 V supply connects 2-ohm and 4-ohm resistors in series. A student incorrectly calculates total resistance as 3 ohms, then uses that result consistently to find current and power.

1. Find the correct resistance, current and total power.

2. Identify the student's originating error and their resulting values.

3. Explain how an official rubric might distinguish the originating error from later consistent work.

Use evidence and show the relationships in your reasoning. Additional paper is permitted.

A ray measured from which line?

Wave behavior | constructed refraction model

Name _____ Date _____

Light travels from air (n=1.00) into glass (n=1.50). The incident ray makes 30 degrees with the normal. Use Snell's law.

1. Find the refracted angle to the nearest degree.

2. State whether the ray bends toward or away from the normal.

3. Explain how the result would change if 30 degrees had been measured from the surface instead.

Use evidence and show the relationships in your reasoning. Additional paper is permitted.

The vector survives the calculation

Motion and forces | constructed momentum

Name _____ Date _____

A 2 kg cart moves east at 3 m/s and then west at 1 m/s. Take east as positive. The change occurs over 0.5 s.

1. Calculate the change in momentum.

2. Find the average net force with direction.

3. Explain why subtracting speed magnitudes alone gives a different result.

Use evidence and show the relationships in your reasoning. Additional paper is permitted.

A photon between two levels

Modern physics | constructed energy-level model

Name _____ Date _____

An atom drops from -2.0 eV to -5.0 eV. Use h=6.63e-34 J s and 1 eV=1.60e-19 J. The change emits one photon.

1. Find the photon energy in eV and joules.

2. Calculate its frequency.

3. Explain why the emitted photon energy is positive despite negative level labels.

Use evidence and show the relationships in your reasoning. Additional paper is permitted.

The charge-distance comparison

Fields and interactions | constructed electrostatic model

Name _____ Date _____

Two point charges are separated by distance r. A second configuration keeps the charges fixed but doubles their separation. Use the inverse-square force model.

1. Compare force magnitudes.

2. Explain the direction relationship for opposite charges.

3. State a model condition relevant to using the point-charge law.

Use evidence and show the relationships in your reasoning. Additional paper is permitted.