

Concept and Skill Dependencies

The table below is intended to catalog how one concept/skill depends on another. “Depend” means that prior experience and knowledge that builds. An apt analogy is the foundation of a house. The foundation comes first, followed by a frame and then walls and a roof. The foundation makes building the rest of the house lots easier.

The foundations of science are few in number. They are akin to schemas—the cognitive patterns that show up and get used over and over again in a variety of contexts. For example, problem-solving with ratios is a foundational schema that gets used to understand chemical formulas, conversions, gas laws, and stoichiometry. Traditional chapter titles in a chemistry textbook (periodic table, qualitative analysis, equilibrium, etc.) are not schemas.

There are six identified schemas in spring semester. They are listed in the left-most column in the table above as they appear in the textbook. This list is a report of what is there, not what should be or should not be there. Effective teachers think and teach in terms of schemas. Effective curricula are designed around the relatively few schemas that result in a scientifically literate student. When a curriculum is organized around a few, foundational schema, the curriculum is focused. When student experiences with each schema are appropriately sophisticated and detailed the curriculum is rigorous. When student experiences with each schema are connected in a logical sequence (story line), the curriculum is coherent.

Chapter 11			
Target concept/skill	Location in Spring (chapter/lesson)	Dependent prior knowledge/skill	Location of dependent knowledge/skill in previous chapters
Collecting data, recording observations, generating graphs, interpreting graphs.	Ch 11 , Explore, Part A, Step 3-5 and all of Part B, Elaborate Part B (coral bleaching graphs).	Significant prior examples of graphing.	Ch 8 , Explore/Explain 1 (conservation of mass) Part A, Steps 2-10. Ch 4 Explore, all of Part B (half-life graphs). Ch 2 Explore, Part B (ionization energy graph). Appendix C4.2 .
System inputs, outputs, feedback, and balance.	Ch 11 , Explore, lesson introductory paragraph and all of Part C; Explain, reading on energy balance; Elaborate Part A reading on coral bleaching.	Conservation of mass, balanced chemical equations, conservation of energy.	Ch 8 Explore/Explain 2 (bond energies) Parts A and B.
Learning mechanics of a simulation in order to collect data, evaluate models, and reach conclusions.	Ch 11 , Evaluate Parts A and B (PhET simulation of greenhouse effect).	Significant prior examples of simulation work.	Ch 8 , Explore/Explain all of Part B (PhET simulation on balancing equations).

Chapter 12

Target concept/skill	Location in Spring (chapter/lesson)	Dependent prior knowledge/skill	Location of dependent knowledge/skill in previous chapters
Designing an investigation.	Ch 12 , Explore, Part A (Cartesian Diver);	Significant prior examples of designing an investigation.	Ch 8 , Explore/Explain 1, Part A (conservation of mass). Appendix 3.2
Learning mechanics of a simulation in order to collect data, evaluate models, and reach conclusions.	Ch 12 , Explain Steps 4-8 (KMT simulation); Elaborate (PhET greenhouse effect simulation).	Significant prior examples of simulation work.	Ch 11 , Evaluate Parts A and B (PhET simulation of greenhouse effect); Ch 8 , Explore/Explain all of Part B (PhET simulation on balancing equations).
Generating a one-pager.	Ch 12 , Evaluate, Steps 5-6. (cloud formation).	Previous one-pagers.	Ch 7 , Evaluate (intermolecular bond types); Ch 6 , Evaluate (water bending)

Chapter 13

Target concept/skill	Location in Spring (chapter/lesson)	Dependent prior knowledge/skill	Location of dependent knowledge/skill in previous chapters
Designing and interpreting an investigation.	Ch 13 , Explore, all of Part B (combustion reaction in candle flame).	Significant prior examples of design and interpretation of investigations work.	Ch 12 , Explore, Part A (Cartesian Diver); Ch 8 , Explore/Explain 1, Part A (conservation of mass).
Using ratios to determine amounts.	Ch 13 , Explain, all of Part A and B (mole, mole ratios, and stoichiometry).	Significant prior examples of using ratios to determine amounts.	Ch 8 , Explore/Explain 1, Part B (determining coefficients of balanced equations); Explore/Explain 2, Parts A and B (bond energy and enthalpy of reaction); Ch 5 , Elaborate, Part B (determining formulas of ionic compounds); Ch 4 , Explain, Part B (half-life); Ch 2 , Explain, Part B (determining formula of compounds).

Chapter 14

Target concept/skill	Location in Spring (chapter/lesson)	Dependent prior knowledge/skill	Location of dependent knowledge/skill in previous chapters
Designing and interpreting an investigation.	Ch 14 , Explore, all of Part A (Alka Seltzer tablet rates);	Significant prior examples of designing an investigation.	Ch 13 , Explore, all of Part B (combustion reaction in candle flame); Ch 12 , Explore, Part A (Cartesian Diver); Ch 8 , Explore/Explain 1, Part A (conservation of mass).
Collecting data, recording observations, interpreting results.	Ch 14 , Explore/Explain Parts B and C (collision theory and rates).	Significant prior examples of recording observations and interpreting results of an investigation.	Ch 8 , Explore/Explain 1 (conservation of mass) Part A, Steps 2-10. Ch 4 Explore, all of Part B (half-life graphs). Ch 2 Explore, Part B (ionization energy graph). Appendix C4.2 .
Generating a one-pager.	Ch 14 , Elaborate (explaining acid/base equilibrium demonstration).	Significant prior examples of one-pagers.	Ch 7 , Evaluate (intermolecular bond types); Ch 6 , Evaluate (water bending)

Chapter 15

Target concept/skill	Location in Spring (chapter/lesson)	Dependent prior knowledge/skill	Location of dependent knowledge/skill in previous chapters
System inputs, outputs, feedback, and balance.	Ch 15 , Explore, Parts A and B (equilibrium shifts involving precipitation and dissolving reactions)	Significant prior examples of system inputs, outputs, feedback, and balance.	Ch 12 , Explain Steps 4-8 (KMT simulation); Elaborate (PhET greenhouse effect simulation); Ch 11 , Evaluate Parts A and B (PhET simulation of greenhouse effect); Ch 8 , Explore/Explain 1 (conservation of mass) Part A, Steps 2-10; Explore/Explain 2 (bond energies) Parts A and B.
Using ratios to determine amounts.	Ch 15 , Explain, Parts A and B (concentration and dilutions).		Ch 13 , Explain, all of Part A and B (mole, mole ratios, and stoichiometry); Ch 8 , Explore/Explain 1, Part B (determining coefficients of balanced equations); Explore/Explain 2, Parts A and B (bond energy and enthalpy of reaction); Ch 5 , Elaborate, Part B (determining formulas of ionic compounds); Ch 4 , Explain, Part B (half-life); Ch 2 , Explain, Part B (determining formula of compounds).
Designing and interpreting an investigation.	Ch 15 , Elaborate (local water quality with test strips).	Significant prior examples of designing and interpreting an investigation.	Ch 14 , Explore, all of Part A (Alka Seltzer tablet rates); Ch 13 , Explore, all of Part B (combustion reaction in candle flame); Ch 12 , Explore, Part A (Cartesian Diver); Ch 8 , Explore/Explain 1, Part A (conservation of mass).

Chapter 16

Target concept/skill	Location in Spring (chapter/lesson)	Dependent prior knowledge/skill	Location of dependent knowledge/skill in previous chapters
System inputs, outputs, feedback, and balance.	Ch 16 , Explore, Part A (shifts in acid/base equilibrium); Explain, Parts A and B (H^+ ion concentration and weak/strong acids); Elaborate (equilibrium shifts in carbonic acid equilibrium in ocean).	Significant prior examples to system inputs, outputs, feedback, and balance.	Ch 15 , Explore, Parts A and B (equilibrium shifts involving precipitation and dissolving reactions); Ch 12 , Explain Steps 4-8 (KMT simulation); Elaborate (PhET greenhouse effect simulation); Ch 11 , Evaluate Parts A and B (PhET simulation of greenhouse effect); Ch 8 , Explore/Explain 1 (conservation of mass) Part A, Steps 2-10; Explore/Explain 2 (bond energies) Parts A and B.
Using ratios to determine amounts.	Ch 16 , Explain, Parts A and B (calculating molarity of H^+ ion concentration in weak/strong acids).	Significant prior examples of using ratios to determine amounts.	Ch 15 , Explain, Parts A and B (concentration and dilutions); Ch 13 , Explain, all of Part A and B (mole, mole ratios, and stoichiometry); Ch 8 , Explore/Explain 1, Part B (determining coefficients of balanced equations); Explore/Explain 2, Parts A and B (bond energy and enthalpy of reaction); Ch 5 , Elaborate, Part B (determining formulas of ionic compounds); Ch 4 , Explain, Part B (half-life); Ch 2 , Explain, Part B (determining formula of compounds).

Chapter 17

Target concept/skill	Location in Spring (chapter/lesson)	Dependent prior knowledge/skill	Location of dependent knowledge/skill in previous chapters
System inputs, outputs, feedback, and balance.	Ch 17 , Engage (other natural cycles); Explain (carbon reservoirs and cycles); Elaborate (connecting carbon reservoirs with chemical reactions).	Significant prior examples to system inputs, outputs, feedback, and balance.	Ch 15 , Explore, Parts A and B (equilibrium shifts involving precipitation and dissolving reactions); Ch 12 , Explain Steps 4-8 (KMT simulation); Elaborate (PhET greenhouse effect simulation); Ch 11 , Evaluate Parts A and B (PhET simulation of greenhouse effect); Ch 8 , Explore/Explain 1 (conservation of mass) Part A, Steps 2-10; Explore/Explain 2 (bond energies) Parts A and B.
Learning mechanics of a simulation in order to collect data, evaluate models, and reach conclusions.	Ch 17 , Evaluate, Part C (simulation to reduce global temperature increase through carbon inputs)	Significant prior examples of learning mechanics of a simulation in order to collect data, evaluate models, and reach conclusions.	Ch 12 , Explain Steps 4-8 (KMT simulation); Elaborate (PhET greenhouse effect simulation); Ch 11 , Evaluate Parts A and B (PhET simulation of greenhouse effect); Ch 8 , Explore/Explain all of Part B (PhET simulation on balancing equations).