CAREER FOCUS

Power Planner Engineer

ACADEMIC FOCUS

Ratios, proportions, and quantitative reasoning are used to help students understand the total power output of differing power scenarios.

Contents of this lesson plan

In Power Planner 1, students begin an inquiry-driven series of activities on the amount of power Whyville should use each week. Students decide how much power should be generated in Whyville and decide which mix of energy sources will be used to fulfill energy demands. Emissions, land use, and cost are factors that affect the students' choice of energy sources. The first step of this process involves manipulating a console to explore the mix of power plant types generating power for the city.

By completing this lesson, students will better understand the total and relative amount of power created by each energy source, and students will use ratios, proportions, and quantitative reasoning as they evaluate power scenarios. Students progress towards earning their Power Planner Engineer career badge. Finally, students will demonstrate learning aligned to academic standards, and will complete the CONNECT worksheet, demonstrating deeper learning from the activity.

Grant funding from the Texas Workforce Commission and U.S. Department of Labor. Grant funding from Next Generation Learning Challenges.

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POWER PLANNER 1 in Whyville

TEACHER PREPARATION

Review this prior to class!

Instructional Approach

This lesson plan uses directed inquiry to lead students to discover the questions they should ask about a topic, and the answers to those questions.

Teacher's Role

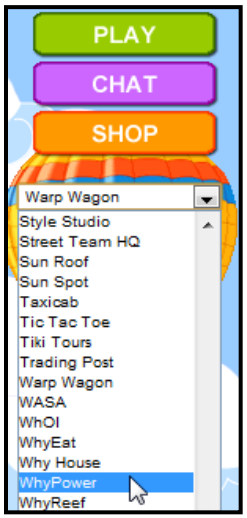
The teacher's role is classroom facilitator and expert consultant. You will lead students to explore and help them when they have problems. Many students will learn much more than is formally included in this lesson plan, and they will also be able to help other students.

Materials

1. Computers with Internet access and confirmed access to Whyville
2. CONNECT worksheet, included in this lesson plan
3. Calculator (optional)

Power Planner 1 is the first in a series of lessons that introduce students, through exploration and practice, to concepts related to making an informed decision about power policy in Whyville. Ultimately, in Power Planner 3, students will make an informed vote on the coming week's power policy.

These instructions are for the teacher only! They help you quickly learn about the Whyville content and see how the lessons are learned by the students. When class time arrives, follow the instructions in *PART 1* -- *EXPLORE*, and let the students explore the content and discover the lessons on their own.



1. Log into Whyville and select *WhyPower* from the Bus menu (see picture →).
2. Click the link *WhyPower Station.*
3. Click the link *Power Planner Central*. Once inside, click on the practice pages on Stacy's desk or click on the *Practice Worksheets* link.
4. Read the introduction for the *Compute Power Generated* section. Note each power plant and how much power each produces.

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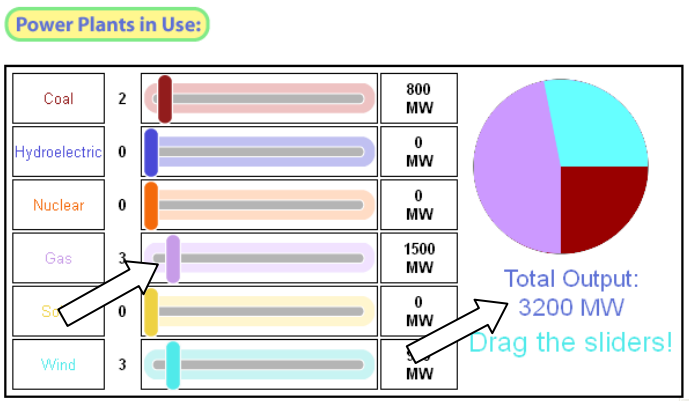
5. Looking at the Power Analyzer, notice the slider bars to the left of the pie chart. Sliding these bars to the right will allocate more power plants of that type. Sliding these bars to the left will remove power plants of that type.

6. As the slider bars are manipulated, the pie chart to the right will reflect the new proportions of power output. The total power output is listed just below the pie chart. This information will be useful for answering questions.

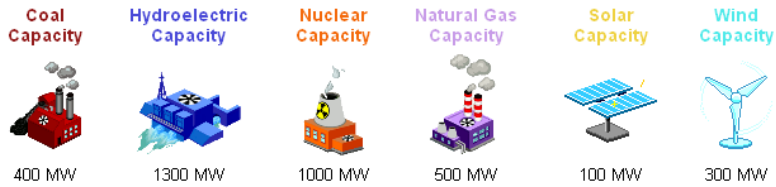


1. Drag the sliders to show:
   - 2 Coal
   - 3 Gas
   - 3 Wind

   What is the total power generated by this scenario? MW Submit

7. Manipulate the sliders to answer the questions for the lesson.

8. In question 3, students are presented with four scenarios. These scenarios represent the power voting choices for that week. Some of the scenarios may exceed the quantitites available on the slider bars. To answer these questions, students will need to use arithmetic and, optionally, a calculator. To do the arithmetic, students will need to know how much power each type of plant produces. This information can be found just above the Power Analyzer.



9. Finally, four power scenarios are presented, each made up of a unique mix of power plants. Two of the scenarios will represent a low power output and two of the scenarios will represent a higher power output. (In the Power Planner 2 lesson, students will conclude whether the higher or lower power output is best for Whyville's citizens.)

A. 33 Hydroelectric , 18 Solar , 19 Wind
50400 MW
Yay! You got it.
B. 12 Coal , 15 Hydroelectric , 16 Nuclear , 12 Gas , 11 Solar , 10 Wind
50400 MW
Yay! You got it.
C. 14 Coal , 10 Hydroelectric , 7 Nuclear , 15 Gas , 10 Solar , 3 Wind
35000 MW
Yay! You got it.
D. 22 Hydroelectric , 16 Solar , 16 Wind
35000 MW Submit

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SCIENCE -- ENERGY TYPES

Power Planner 1 exposes students to six primary sources of energy in large-scale energy production: coal, natural gas, nuclear, hydroelectric, wind, and solar energy. In other lessons, students place the power plants and collectors around Whyville, learning what is required for each type of energy (like a river for hydroelectric) and what constitutes wise placement. In later Power Planner lessons, students must consider other factors regarding these sources; for example, emissions. In this lesson plan, students are exposed to how much energy each can generate, and are therefore forced to consider to what degree various energy sources are able to meet modern power needs.

SCIENCE -- ENERGY MEASUREMENTS

While the current lesson is primarily focused on math content, there is meaningful science content in the lesson. First, the lesson reinforces the existence of multiple sources of large scale power, as listed above. Second, it lists the rate of energy generation of each source, helping students understand that different sources have different capacities to meet our power needs. Although not present in this lesson, Power Planner 3 will introduce the factors of emissions and land use.

Depending on the sequence in which you are using WhyPower lessons, this may be the first exposure of students to megawatts and megawatt-hours. This can be a difficult concept to describe. A megawatt is a *rate* of energy usage, even though that's not obvious from the name. Megawatts are like Miles per hour (mph). Miles per hour indicate how fast a car is going at a moment in time. Similarly, megawatts indicate how much energy is being used at a moment in time. Megawatt-hours indicate how much *total* energy is used, just like "miles" indicates total distance traveled. The important thing to remember about a megawatt-hour is that it is a measure of energy use over any time period, not just over one hour! The specific definition of a watt is Joules/second. A Joule is an absolute amount of energy.

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Term	Definition	Is this a Rate of use, or Total use?	It's analogous to …
Megawatts	The rate of usage of power in some process (like running an entire factory)	Rate of use	Miles per hour
Megawatt-hours	Total energy use over some amount of time	Total use	Total miles traveled

MATH

Math is the primary focus of the Power Planner 1 lesson. The power supply problem establishes a powerful real world context for students to learn math concepts. The majority of the math in this lesson focuses on using rational numbers, fractions, percentages, and understanding proportional relationships. Students transpose data from a graphical format to a written format and also use the graphs to answer questions. By manipulating the slider bars, students can understand how the increase or decrease of power plants affects the total power output and relative power output of the system.

The chart below summarizes the math standards taught by this lesson. This chart covers all Power Planner lesson plans.

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Covered in Power Planner Activity #	TEKS Reporting Category	Texas College Readiness Standard?	Texas Standard #	Description
1, 3	**QUANTITATIVE REASONING**	**YES**	**8.1A**	**compare and order rational numbers in various forms including integers, percents, and positive and negative fractions and decimals; Readiness Standard**
1, 3	QUANTITATIVE REASONING	NO	8.1B	select and use appropriate forms of rational numbers to solve real-life problems including those involving proportional
3	QUANTITATIVE REASONING	NO	8.1C	approximate (mentally [and with calculators]) the value of irrational numbers as they arise from problem situations (such as π, 2);
	QUANTITATIVE REASONING	NO	8.1D	(D) express numbers in scientific notation, including negative exponents, in appropriate problem situations.
1, 3	QUANTITATIVE REASONING	NO	8.2A	select appropriate operations to solve problems involving rational numbers and justify the selections; Supporting Standard
1, 3	**QUANTITATIVE REASONING**	**YES**	**8.2B**	**use appropriate operations to solve problems involving rational numbers in problem situations; Readiness Standard**
3	QUANTITATIVE REASONING	NO	8.2C	evaluate a solution for reasonableness; and Supporting Standard
1	QUANTITATIVE REASONING	NO	8.2D	use multiplication by a given constant factor (including unit rate) to represent and solve problems involving proportional relationships including conversions between measurement systems.
1, 3	ALGEBRAIC REASONING	YES	8.3B	estimate and find solutions to application problems involving percents and other proportional relationships such as similarity and rates. Readiness Standard
2	ALGEBRAIC REASONING	YES	8.4A	(A) generate a different representation of data given another representation of data (such as a table, graph, equation, or verbal description). Readiness Standard
ALL	ALGEBRAIC REASONING	YES	8.5A	(A) predict, find, and justify solutions to application problems using appropriate tables, graphs, and algebraic equations; and
1	MEASUREMENT	YES	8.9B	(B) use proportional relationships in similar two-dimensional figures or similar three-dimensional figures to find missing measurements.
2	PROBABILITY& STATISTICS	YES	8.11A	(A) find the probabilities of dependent and independent events; and
2, 3	PROBABILITY& STATISTICS	NO	8.11B	(B) use theoretical probabilities and experimental results to make predictions and decisions. Supporting Standard
2	PROBABILITY& STATISTICS	NO	8.12A	(A) use variability (range, including interquartile range (IQR)) and select the appropriate measure of central tendency to describe a set of data and justify the choice for a particular situation;
2, 3	PROBABILITY& STATISTICS	NO	8.12B	draw conclusions and make predictions by analyzing trends in scatterplots; and Supporting Standard
ALL	UNDERLYING PROCESSES & TOOLS	NO	8.14A	identify and apply mathematics to everyday experiences, to activities in and outside of school, with other disciplines, and with other mathematical topics;
ALL	UNDERLYING PROCESSES & TOOLS	NO	8.14B	use a problem-solving model that incorporates understanding the problem, making a plan, carrying out the plan, and evaluating the solution for reasonableness;
ALL	UNDERLYING PROCESSES & TOOLS	NO	8.14C	select or develop an appropriate problem-solving strategy from a variety of different types, including drawing a picture, looking for a pattern, systematic guessing and checking, acting it out, making a table, working a simpler problem, or working backwards to solve a problem; and
ALL	UNDERLYING PROCESSES & TOOLS	NO	8.14D	select tools such as real objects, manipulatives, paper/pencil, and technology or techniques such as mental math, estimation, and number sense to solve problems.
ALL	UNDERLYING PROCESSES & TOOLS	NO	8.15A	(A) communicate mathematical ideas using language, efficient tools, appropriate units, and graphical, numerical, physical, or algebraic mathematical models.
ALL	UNDERLYING PROCESSES & TOOLS	NO	8.16A	make conjectures from patterns or sets of examples and nonexamples; and
ALL	UNDERLYING PROCESSES & TOOLS	NO	8.16B	validate his/her conclusions using mathematical properties and relationships.

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Starter Question 3 minutes

If you had to fill your city's power demand, what energy sources would you use?

Perform these *Teacher Actions* *Do these in the order indicated*	Expect this *Student Experience* *You should see your students experience the following*
1. ENGAGE (3 minutes) Ask students the Starter Question. Facilitate a class discussion for three minutes and help the students take ownership of the lesson.	**ENGAGEMENT** Students take ownership while they are discussing a question that matters to them.
2. DIRECT (2 minutes) Direct students to log into Whyville, go to *WhyPower*, and then to *WhyPower Station*, and then to *Power Planner Central*. Direct them to visit the *Practice Worksheets* instead of the *Voting Worksheets*. NOTE: Avoid giving further directions. Let them explore individually in teams and figure out for themselves what is going on, and how to be successful in the activities.	**EXPLORATION** After the starter question, students quickly log in and are in the *Power Planner – Compute Power Generated* practice worksheet, exploring the lesson and learning what is important and how to be successful.
3. COACH (15 minutes) Wander around the room, encourage students to help each other, and help individual students if they cannot work through problems. Ask students what the activity is, what is important to succeed, and where they have additional questions.	

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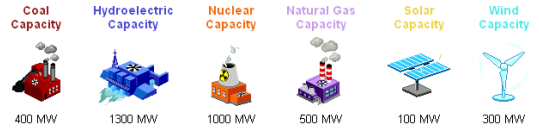
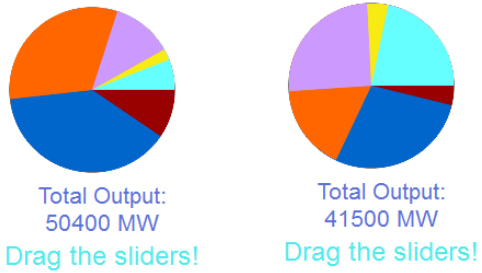
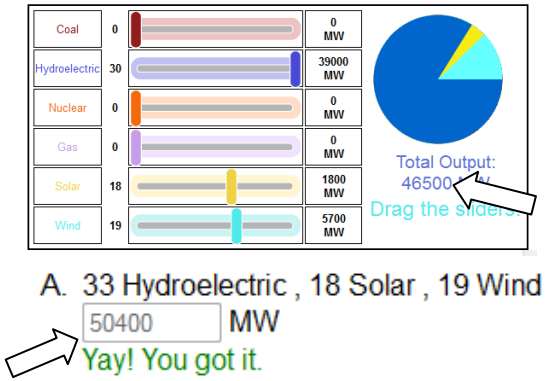
WHERE DO THE LESSONS APPEAR? Recognize where the core content shows up.

		
Students must recognize that the various plants generate different amounts of electricity in megawatts by viewing the power plant info graph.	Students understand that as the mix of power plants changes, the relative amount of power generated by each power type will also change.	Students must use arithmetic or calculators to compute the amount of power necessary for the four voting scenarios. By design, some scenarios will exceed the quantities available on the slider bars.

	Perform these *Teacher Actions* *Do these in the order indicated*	Expect this *Student Experience* *You should see your students experience the following*
1.	**GATHER** Give students a warning that exploration time is almost over. After a minute has passed, have the students direct their attention towards you.	**GATHERING** Students wrap-up their self-guided exploration and turn their full attention to the discussion.
2.	**FACILITATE** Lead students to discuss the questions below. Guide them, and resist any urge to give them the answers.	**REFLECTING (group)** Students share their ideas and refine their ideas in large group discussion.

Questions

	Question	Expected Answer
1.	What is happening in this lesson?	Different power scenarios create different amounts of total power. Differing scenarios result in changes in the percentage of power output, for each energy source.
2.	How do you succeed in this lesson?	Understanding the proportion of energy contributed by each energy source, for any given scenario. Progressing toward a Power Planner Engineer badge.
3.	What do you need to know to succeed?	The total amount of power each plant generates. The total amount of power that each voting scenario generates.
4.	What questions do you still have?	
5.	Beyond being graded, do you care about this? Does this topic affect your life?	
6.	Name a real world job that is like this job.	Energy Analyst. *NOTE to teachers*: Use the students' knowledge of their parents' jobs, their real world experience, and their common sense to answer this question, and also any content the students have encountered in other career exploration resources.

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	Perform these *Teacher Actions* ***Do these in the order indicated***	Expect this *Student Experience* ***You should see your students experience the following***
1.	**DIRECT** Tell the students that their goal is to progress toward their Power Planner Engineer career badges. They do this by completing the *Compute Power Generated* (first) activity in Power Planner Central.	**ACCOMPLISHING** Students work independently to progress toward their badges. Take advantage of students moving quickly by having them help other students.
2.	*Transition to* **CONNECT** As students finish and have no others to help, direct them to complete the CONNECT worksheet.	**CONNECTING** Students complete the worksheet, demonstrating their mastery of relevant standards and their understanding of real world applications.

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Name and Date		
Class Period and Whyville ID		
1. What was this lesson about?		
2. What did you need to know to succeed?		
3. What new questions did you think of while playing through this lesson?		
4. How many power sources do you think your power company uses in the real world? Do you see any strengths in using only a few types of power sources? Do you see any strengths in using many power sources?		
5. Did you notice any similarities among any of the power scenarios? How were the scenarios different?		
6. Which energy source had the largest effect on power output? Which had the smallest effect?		

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Name and Date		
Class Period and Whyville ID		
1. What's more important to you: 1) the amount of power created for the week or 2) the sources of power used to generate power? Why?		
2. Which scenario used the largest percentage of nonrenewable sources to produce power?		
3. Which scenario used the largest percentage of renewable & alternative sources to produce power?		
4. Some of the power scenarios created more power than the others. By what factor was the larger scenario bigger than the smaller power choice?		
5. List the percentage contribution of each power type from scenario 4.		

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6. Is more power always better? Can you think of a time of year when you'd need a lot of energy? What about a time of year when you wouldn't need as much energy? Which costs more? Why?	
7. Make a power scenario based on your preferences: How many of each power source do you use? How much total power is generated from your power scenario? Did you pick the mix of power sources that you chose for any particular reason?	
8. Did any of the power sources produce similar amounts of power?	
9. Do you think there are jobs in the real world where people look at and understand how much of our power comes from different sources? Would a job like that be interesting? Would a job like that be important?	
10. Do you care about what you learned? Is it relevant to your life? Why or why not? (The only wrong answer is no answer.)	

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TEKS: Career Portals

(1) The student explores one or more career clusters of interest. The student is expected to:
- **(A) identify the various career opportunities within one or more career clusters; and**
- **(B) identify the pathways within one or more career clusters.**

(2) The student explores pathways of interest within one or more career clusters. The student is expected to:
- **(A) investigate career opportunities within the pathways;**
- (B) explore careers of personal interest;

(4) The student explores the professional skills needed for college and career success. The student is expected to:
- (E) identify professional associations affiliated with a specified program of study;
- **(F) employ effective leadership, teamwork, and conflict management;**

TEKS: Career Investigation

(2) The student knows how to locate, analyze, and apply career information. The student is expected to:
- **(A) access career information using print and on-line resources to complete an educational and/or training plan for a career pathway;**
- **(B) access career information using interviews with business and industry representatives to create a career resource file;**

(6) The student knows the process of career planning. The student is expected to:
- **(B) prepare an oral or written plan describing the specific factors considered in the decision-making process used to solve a simulated career problem;**

(8) The student knows the effect change has on society and career opportunities. The student is expected to:
- **(A) cite examples of change in our society;**

TEKS: Exploring Careers

1) The student explores personal interests and aptitudes as they relate to education and career planning. The student is expected to:
- (D) research current and emerging fields related to personal interest areas;
- (F) explore how career choices impact the balance between personal and professional responsibilities; and

(2) The student analyzes personal interests and aptitudes regarding education and career planning. The student is expected to:
- (C) develop and analyze tables, charts, and graphs related to career interests;
- (D) determine the impact of technology on careers of personal interest; and

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(4) The student evaluates skills for personal success. The student is expected to:
- **(A) implement effective study skills for academic success;**
- **(C) use a problem-solving model and critical-thinking skills to make informed decisions;**
- **(D) use effective time-management and goal-setting strategies;**
- **(E) effectively use information and communication technology tools;**

(5) The student recognizes the impact of career choice on personal lifestyle. The student is expected to:
- (A) prepare a personal budget reflecting the student's desired lifestyle;

(7) The student develops skills for professional success. The student is expected to:
- **(E) explore and model characteristics necessary for professional success such as work ethics, integrity, dedication, perseverance, and the ability to interact with a diverse population; and**
- **(F) complete activities using project- and time-management techniques.**

(8) The student identifies and explores technical skills essential to careers in multiple occupations, including those that are high skill, high wage, or high demand. The student is expected to:
- **(A) complete actual or virtual labs to simulate the technical skills required in various occupations; and**
- (B) analyze the relationship between various occupations such as the relationship between interior design, architectural design, manufacturing, and construction on the industry of home building or the multiple occupations required for hospital administration.

TEKS: Mathematics

See also Teacher Preparation section above for a matrix of core math content vs. Whyville activities.

(1) Number, operation, and quantitative reasoning. The student understands that different forms of numbers are appropriate for different situations. The student is expected to:(A) compare and order rational numbers in various forms including integers, percents, and positive and negative fractions and decimals;
- (B) select and use appropriate forms of rational numbers to solve real life problems including those involving proportional relationships;

(2) Number, operation, and quantitative reasoning. The student selects and uses appropriate operations to solve problems and justify solutions. The student is expected to:
- (A) select appropriate operations to solve problems involving rational numbers and justify the selections;
- (B) use appropriate operations to solve problems involving rational numbers in problem situations;
- **(D) use multiplication by a given constant factor (including unit rate) to represent and solve problems involving proportional relationships including conversions between measurement systems.**

(3) The student identifies proportional or non-proportional linear relationships in problem situations and solves problems. The student is expected to:
- **(B) estimate and find solutions to application problems involving percents and other proportional relationships such as similarity and rates.**

(5) **Patterns, relationships, and algebraic thinking. The student uses graphs, tables, and algebraic representations to make predictions and solve problems**. The student is expected to:

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(A) predict, find, and justify solutions to application problems using appropriate tables, graphs, and algebraic equations;

(9) The student uses indirect measurement to solve problems. The student is expected to

(B) use proportional relationships in similar two-dimensional figures or similar three-dimensional figures to find missing measurements.

(14) Underlying processes and mathematical tools. The student applies Grade 8 mathematics to solve problems connected to everyday experiences, investigations in other disciplines, and activities in and outside of school. The student is expected to:

(A) **identify and apply mathematics to everyday experiences, to activities in and outside of school, with other disciplines, and with other mathematical topics;**

(B) use a problem-solving model that incorporates understanding the problem, making a plan, carrying out the plan, and evaluating the solution for reasonableness;

(C) select or develop an appropriate problem-solving strategy from a variety of different types, including drawing a picture, looking for a pattern, systematic guessing and checking, acting it out, making a table, working a simpler problem, or working backwards to solve a problem; and

(D) select tools such as real objects, manipulatives, paper/pencil, and technology or techniques such as mental math, estimation, and number sense to solve problems.

(15) Underlying processes and mathematical tools. The student communicates about Grade 8 mathematics through informal and mathematical language, representations, and models. The student is expected to:

(A) communicate mathematical ideas using language, efficient tools, appropriate units, and graphical, numerical, physical, or algebraic mathematical models; and

(16) Underlying processes and mathematical tools. The student uses logical reasoning to make conjectures and verify conclusions. The student is expected to:

(A) make conjectures from patterns or sets of examples and nonexamples; and

(B) validate his/her conclusions using mathematical properties and relationships.

TEKS: Science

(3) Scientific investigation and reasoning. The student uses critical thinking, scientific reasoning, and problem solving to make informed decisions and knows the contributions of relevant scientists. The student is expected to:

(A) in all fields of science, analyze, evaluate, and critique scientific explanations by using empirical evidence, logical reasoning, and experimental and observational testing, including examining all sides of scientific evidence of those scientific explanations, so as to encourage critical thinking by the student;

(B) use models to represent aspects of the natural world such as an atom, a molecule, space, or a geologic feature;

(C) identify advantages and limitations of models such as size, scale, properties, and materials;

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Blooms (Taxonomy):

X	Knowledge: arrange, define, duplicate, label, list, memorize, name, order, recognize, relate, recall, repeat, reproduce state.
X	Comprehension: classify, describe, discuss, explain, express, identify, indicate, locate, recognize, report, restate, review, select, translate
X	Application: apply, choose, demonstrate, dramatize, employ, illustrate, interpret, operate, practice, schedule, sketch, solve, use, write.
X	Analysis: analyze, appraise, calculate, categorize, compare, contrast, criticize, differentiate, discriminate, distinguish, examine, experiment, question, test.
X	Synthesis: arrange, assemble, collect, compose, construct, create, design, develop, formulate, manage, organize, plan, prepare, propose, set up, write.
X	Evaluation: appraise, argue, assess, attach, choose compare, defend estimate, judge, predict, rate, core, select, support,

Instructional Strategies:

X	Identifying similarities and differences
X	Summarizing and note taking
X	Reinforcing effort and providing recognition
	Homework and practice
X	Nonlinguistic representations
X	Cooperative learning
X	Setting objectives and providing feedback
	Generating and testing hypotheses
X	Cues, questions, and advanced organizers

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Sixth Grade

Subcategory	*Standard ID*	*Standard Description*
Ratios and Proportions	6.RP.1	Understand the concept of a ratio and use ratio language to describe a ratio relationship between two quantities. For example, "The ratio of wings to beaks in the bird house at the zoo was 2:1, because for every 2 wings there was 1 beak." "For every vote candidate A received, candidate C received nearly three votes."
Ratios and Proportions	**6.RP.2**	**Understand the concept of a unit rate a/b associated with a ratio a:b with b ≠ 0, and use rate language in the context of a ratio relationship. For example, "This recipe has a ratio of 3 cups of flour to 4 cups of sugar, so there is 3/4 cup of flour for each cup of sugar." "We paid $75 for 15 hamburgers, which is a rate of $5 per hamburger."**
Ratios and Proportions	**6.RP.3.A**	**Use ratio and rate reasoning to solve real world and mathematical problems, e.g., by reasoning about tables of equivalent ratios, tape diagrams, double number line diagrams, or equations. a. Make tables of equivalent ratios relating quantities with whole number measurements, find missing values in the tables, and plot the pairs of values on the coordinate plane. Use tables to compare ratios.**
Ratios and Proportions	6.RP.3.B	Use ratio and rate reasoning to solve real world and mathematical problems, e.g., by reasoning about tables of equivalent ratios, tape diagrams, double number line diagrams, or equations. b. Solve unit rate problems including those involving unit pricing and constant speed. For example, if it took 7 hours to mow 4 lawns, then at that rate, how many lawns could be mowed in 35 hours? At what rate were lawns being mowed?

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Subcategory	*Standard ID*	*Standard Description*
Ratios and Proportions	6.RP.3.C	Use ratio and rate reasoning to solve real world and mathematical problems, e.g., by reasoning about tables of equivalent ratios, tape diagrams, double number line diagrams, or equations. c. Find a percent of a quantity as a rate per 100 (e.g., 30% of a quantity means 30/100 times the quantity); solve problems involving finding the whole, given a part and the percent.
Expressions and Equations	**6.EE.7**	**Solve real world and mathematical problems by writing and solving equations of the form x + p = q and px = q for cases in which p, q and x are all nonnegative rational numbers.**

Seventh Grade

Subcategory	*Standard ID*	*Standard Description*
Ratios and Proportions	7.RP.2.C	Recognize and represent proportional relationships between quantities. c. Represent proportional relationships by equations. For example, if total cost t is proportional to the number n of items purchased at a constant price p, the relationship between the total cost and the number of items can be expressed as t = pn.
Expressions and Equations	**7.EE.3**	**Solve multi-step real life and mathematical problems posed with positive and negative rational numbers in any form (whole numbers, fractions, and decimals), using tools strategically. Apply properties of operations to calculate with numbers in any form; convert between forms as appropriate; and assess the reasonableness of answers using mental computation and estimation strategies. For example: If a woman making $25 an hour gets a 10% raise, she will make an additional 1/10 of her salary an hour, or $2.50, for a new salary of $27.50. If you want to place a towel bar 9 3/4 inches long in the center of a door that is 27 1/2 inches wide, you will need to place the bar about 9 inches from each edge; this estimate can be used as a check on the exact computation.**

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Subcategory	*Standard ID*	*Standard Description*
Expressions and Equations	**7.EE.4.A**	**Use variables to represent quantities in a real world or mathematical problem, and construct simple equations and inequalities to solve problems by reasoning about the quantities. a. Solve word problems leading to equations of the form px + q = r and p(x + q) = r, where p, q, and r are specific rational numbers. Solve equations of these forms fluently. Compare an algebraic solution to an arithmetic solution, identifying the sequence of the operations used in each approach. For example, the perimeter of a rectangle is 54 cm. Its length is 6 cm. What is its width?**
Expressions and Equations	**7.EE.4.B**	**Use variables to represent quantities in a real world or mathematical problem, and construct simple equations and inequalities to solve problems by reasoning about the quantities. b. Solve word problems leading to inequalities of the form px + q > r or px + q < r, where p, q, and r are specific rational numbers. Graph the solution set of the inequality and interpret it in the context of the problem. For example: As a salesperson, you are paid $50 per week plus $3 per sale. This week you want your pay to be at least $100. Write an inequality for the number of sales you need to make, and describe the solutions.**

Eighth Grade

Subcategory	*Standard ID*	*Standard Description*
Expressions and Equations	8.EE.7.B	Solve linear equations in one variable. b. Solve linear equations with rational number coefficients, including equations whose solutions require expanding expressions using the distributive property and collecting like terms.

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