Meeting 7 Fall 2017

Energy
November 15th

Contents

1) Number Talks
2) Energy Costs
3) Generating Energy

Teaching Tips

www.math.uci.edu/mathceo
Planning a Vacation (Meeting 7, Nov 15)

- Identify the Leader mentor
- Write names of any new mentors and students
  (find form inside folder, write new names if needed)
- Place checkmarks in the Meeting 7 column (same form inside folder)
- Tell math goals to students in each activity
- Call students by name
- Keep students silence while doing Quiz
- Keep your table neat and clean at all times
- Get help if there are behavior problems before they escalate

- Quiz PROBLEM 1 (pink) (end of Activity 2)
- Student Survey (pink) (start survey at 3:35 PM)
- Fill Meeting Report (blue) (if you are the Leader)
- Put back into folder: Student Surveys (pink), Meeting Report (blue)
Meeting 7: Energy

Dear mentor,

In Meeting 7 students will explore different concepts related to energy, including the notions of Wattage and kW.h (Kilowatt hour), the difference between power and energy, and how to compute costs when using appliances that produce energy. Students will also simulate a city managing power plants, exploring the pros and cons of different energy options and gaining skills in optimization and balance when dealing with options.

Topics: power, energy, wattage, percentual increase, proportionality.

Activity Breakdown

Activity 1 “Number Talks”

Activity 2 “Energy Costs”
Calculating energies and costs of running appliances

Assessment

Activity 3 “Energy Generation”
Game with 3 teams (pairs or teams of 3) about building power plants.

Math Goals

Students use different methods to compute percentages and percentile increase.

\[
1 : 3 \\
3/4 \\
y = 3x
\]

Students can solve problems involving costs by using data related to unitary costs and number of units.

Students understand the difference between the rate of change of a quantity and the accumulated quantity through time, in the context of power and energy.

Students make predictions and decisions relative to maximizing a given quantity (energy generated) which include one restrictions (pollution), understanding the relations between quantities and their change over time.
MATERIALS & AGENDA

MATERIALS

INSTRUCTOR MANUAL
Green color

STUDENT WORKBOOK
White color

MEETING REPORT
Blue color
One per table
Online meeting report

STUDENT SURVEYS (INCLUDES QUIZ)
Pink Color

WHITEBOARDS
One per student

DRY ERASE MARKERS
A pouch with several

LOCATION: NS 2 1201 & NS 2 3201

- 2:10 pm  General Introduction  10’
- 2:20 pm  1) Number Talks  15’
- 2:35 pm  2) Energy Costs  15’
- 2:50  Math Assessment  5’
- 2:55 pm  3) Generating Energy  40’
- 3:35  Student Survey  5’
- 3:40  End of the meeting

If you are missing any material, please ask one of our assistants and they will be able to help you. They can also help take your students to the restroom.

Math CEO Facebook Page
https://www.facebook.com/UCIMathCEO

Math CEO You Tube Channel
https://www.youtube.com/channel/UCvMQNFT-hPf-xKsNixhz2YXw
INDIVIDUAL ASSESSMENT

- After Activity 2 there is time for an individual Quiz (PROBLEM 1 IN THE PINK SURVEY). Give students **5 minutes to do both parts A and B** and have them answer individually (in their surveys). After collecting answers, grade them and quickly correct them with the kids (5 minutes).

TIPS

- Build the habit of having students complete the quiz in complete silence and without any help of peers of mentors. This may take a few meetings, but make perfectly clear that we will work with these expectations. Do not ignore this.
- Correcting the Quiz after the students are done can help you check for understanding.

BEHAVIOR EXPECTATIONS

If a kid is behaving improperly or disrupting students, or does not follow directions at all, talk to them. If problem persists or is really serious, please let Brandi, Alessandra, Li-Sheng or an Assistant know immediately.

Refer to the expectations matrix and point to it if students are not meeting expectations.
**UCI MATH CEO MEETINGS: BASIC GUIDELINES FOR VOLUNTEERS**

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<table>
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<tr>
<td>KNOW YOUR STUDENTS</td>
<td>ASK FOR EXPLANATIONS</td>
<td>MOVE &amp; MONITOR</td>
<td>CHECK WORK</td>
<td>AT THE END</td>
</tr>
<tr>
<td>Call students by their names most of the time; make sure they know your name, talk briefly about their day before you start the math activities.</td>
<td>Ask students how they got their answers. Say things like “How do you know?”, “Why?”, “Draw a picture”, “Convince me!”, “Can you explain to Juan?”, etc.</td>
<td>Move around your table; monitor all students; use an adequate tone of voice; encourage kids to work in teams.</td>
<td>Verify that the students write the answers to the problems and that they are correct and complete.</td>
<td>Ask students to fill out the survey individually (no help), and to help pick up trash from the table and floor.</td>
</tr>
</tbody>
</table>

**TEACHING TIPS**

This icon refers to specific tips which you will find embedded in the booklet activities: procedures, questions to ask to the students, recommended methodologies, and so on.

**Example:** After you introduce a new concept, it is a good idea to ask students to rephrase the concept, explain it in their own words. You can choose particular students, for example those who are disengaged.

**Example:** It is convenient to ask one student to read out instructions for a problem or definitions of a concept. This keeps your group focused on the task and improves their reading skills if you give feedback on reading.

**1** Activity to be done in pairs

**2** Activity to be done

**Note:** if not specified, the booklet problem can be done as a group activity involving a discussion.
We describe an activity (taken from the book Making Number Talks Matter) called Number Talk. This is a warm-up activity and will last 15 minutes. There are several advantages: one of them is give more importance to conceptual understanding over knowing procedures without knowing why they work.

A Number Talk has two phases: an individual phase, and a discussion led by the mentor (asking questions and recording both answers and strategies). **Avoid the temptation of explaining and doing the thinking yourself!**
A large group from a Circus Convention will stay at the hotel. You have received a distribution of people, which have requested to book a number of small rooms such that there are 3 people per room in average. How many rooms should we book?

Find the total revenue for these small rooms, given a discount chart for groups, depending on the number of rooms, and this year’s base price of $140 per room.

During last year's Memorial Day the hotel rented 100 rooms for a base price of $140 (before applying the discount as in the chart). How does last year’s revenue compare to the revenue obtained for the 90 small rooms this year? Can you compare in terms of percentages?

The Mentor asks if students want to explain how they figured the problem. Explaining the procedure (steps) is not enough, but they need to explain why it makes sense, why it works.

Use key words or diagrams to register the students explanations. Only mentors can write.

Dig deeper (after each strategy):
- Does anyone have a question for Juan?
- Can you say more about...?
- Can someone explain Juan’s strategy in your own words?
- What connections do you notice among the strategies we have so far?

Instructions

No Pencils & No Papers allowed

Students put their fists in their chest to show they are ready to start.

The mentor writes a problem in the whiteboard for kids to solve, and shows it.

Mentor waits for students to solve the problem individually and silently. Kids put up their thumbs when they are ready. Give enough time.

When ready, the mentor records all answers from students (right or wrong) in a different whiteboard. Just record the answers. No judging or voting are allowed at this stage.
Suggested problems (choose only one for the activity, different from the one done during Meeting 3):

- What is 85% of 120?
- What is 1.25 x 14?
- What is 86 / 7?
- What is 949 / 8.5?
- What is 25% of 150% of 6000?

Examples of strategies (there may be several more)

- 85% of 120: (i) compute 80% of 120, then 5% of 120 and add. (ii) Compute 10% of 120, then 5% by dividing by 2, then 15% by triplicating, and then subtract this from 120 to get the 85% of 120.
- 1.25 x 14: (i) First do 1.25 x 7 and then duplicate. (ii) Duplicate 1.25 and then multiply by 7. (iii) Do 1.25 x 10, 1.25 x 4 and add the results. (iv) First do 1.25 x 15 (multiply by 3, then by 5), and then subtract 1.25. (v) First calculate 1.25 x 16 (by duplicating 4 times) and then subtract 2.5.
- 86/7: Make towers of 7: 7x1=7, ..., 7x10=70, 7x11=77, 7x12=84. So answer is 12 plus 2/7.
- 949/8.5: towers: 8.5 x 100 = 850. 949-850 = 99. Now 8.5x10 = 85 and 99-85=14. So answer is 100+10+ 14/8.5, which is 111 + (5.5 / 8.5) or 111 plus 11/17. (Approx: 111 + 2/3)

Note: approximated answers are also encouraged, as long as the reasoning is mathematically correct.
Our Goals:
Understand and solve problems about proportionality with a visual method and also using equations.

Discuss in your group. Everyone talks.

What is energy? Give some examples of real life situations where energy is generated and indicate the time duration of each event.

Give an example of three different electric appliances and guess their power relations in terms of ratios or fractions. You may use bar models.

If appliance A is twice as powerful as B does it mean it generates twice as much energy as B? Or under which conditions? How can they generate the same energy?
Materials

- Pages 2-7 in the Student Workbook

Introduction

In this activity students will solve real life problems involving energy used and its cost by using multiplications, tables, bar models and other forms of proportionality. Students will also be exposed to proper units dealing with power and energy and understand their relations.

For your reference, we include the definitions of the concepts that will be used throughout the activity.

- **Watt**: it is a unit of power indicating the **rate at which energy is generated or used**. The amount of power required to operate an electrical appliance is called the wattage, and is measured in Watts. A refrigerator has a bigger wattage than a radio, because it requires more power than a radio to run.

- **kW (kilowatt)**: 1 kW is equal to 1000 watts.

- **kW.h (Kilowatt hour)**: the kilowatt hour is a unit of energy. It measures the amount of energy used/produced by an object (such as an electric appliance) with a constant power of 1 kW during 1 hour of continuous use.

  - Example: an electric appliance with 3,000 watts (=3kW) of power working for 2 hours produces an amount of energy equal to 6 kW.h.

  - Example 2: in order to produce 10 kW.h of energy, an object with a power of 5 kW, has to work for a total of 2 hours.

So power (in kW) multiplied by time (in hours) gives energy (in kW.h).

Note: kW.h is NOT kilowatts per hour, because kW.h is not a rate of change or speed, but rather is a measure of energy which is power used through a period of time. You can think of energy being accumulated through time.
2) ENERGY COSTS

Carl’s Toaster has a Wattage of 1100. This means that if we multiply the number of hours the toaster works in a day by 1100, we obtain the number of energy in Watts consumed that day. To find the energy in kW.h (KiloWatts hour) we need to divide this by 1000.

A kW.h is a unit of energy equivalent to 1 kW of power sustained for a complete hour.

Complete the table below:

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Carl has a Coffee Maker of wattage of 1000 and a Microwave oven of wattage 1500. During an 8-day period, he used the Coffee Maker all days, an average of 30 minutes every day, and the Microwave all days, an average of 15 minutes every day.

Which appliance delivers more power? Which appliance used more energy during the 8-day period? By how much?
Carl’s Toaster has a Wattage of 1100. This means that if we multiply the number of hours the toaster works in a day by 1100, we obtain the number of energy in Watts consumed that day. To find the energy in kW.h (KiloWatts hour) we need to divide this by 1000.

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<td>11</td>
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<tr>
<td>15</td>
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</tbody>
</table>

Carl has a Coffee Maker of wattage of 1000 and a Microwave oven of wattage 1500. During an 8-day period, he used the Coffee Maker all days, an average of 30 minutes every day, and the Microwave all days, an average of 15 minutes every day.

Which appliance delivers more power?

Which appliance delivered more energy during the 8-day period? By how much?

Microwave has 50% more power than the Coffee Maker.

We find energies used for each:
- Coffee Maker: used for 4 hours total, so energy is: 1 x 4 = 4 kW.h.
- Microwave: used for 2 hours total, so energy is 1.5 x 2 = 3 kW.h

So **Coffee Maker** used more energy, namely 1 kW.h more.
In Santa Ana, the cost of energy is of US$0.12 per kW.h (kilowatt hour).

For example, if an appliance of Wattage 1000 runs for 4 hours, the kW.h spent is equal to 4 kW.h, and so you will pay 48 cents: $1000 \times 4 \times 0.12 = US\$ 0.48$

(A kW.h is a unit of energy equivalent to 1 kW of power sustained for a complete hour).

If an appliance of wattage 500 runs for 40 hours, how much money do you need to pay for the energy consumed?

An appliance of wattage 600 was used during a 12-day period. If a total of US$0.432 was spent, for how many minutes daily on average was the appliance used?
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(A kW.h is a unit of energy equivalent to 1 kW of power sustained for a complete hour).

If an appliance of wattage 500 runs for 40 hours, how much money do you need to pay for the energy consumed?

Wattage is 500, so 0.5 kW.
Time is 40 hours.
So multiply: $0.5 \times 40 = 20$ kW.h.
Multiply again to get total cost: $20 \times 0.12 = \text{US$2.4}$ (2 dollars and 40 cents)

An appliance of wattage 2000 was used during a 12-day period. If a total of US$1.44 was spent, for how many minutes daily on average was the appliance used?

Wattage is 2000, or 2 kW.
We can assume that the daily use was the same (since we are dealing with averages). Then dividing 1.44 by 12 we get 0.12, which is the cost per day.

We know that for a day: 2 times number of hours times 0.12 equals to 0.12.

So the number of hours must be 0.5, which is equivalent to $30$ minutes.
Our Goals:
To explore numerical situations and use mathematics to reason out the best ways to tackle them.

Discuss in your group... everyone talks!

- What is the difference between fossil fuels and renewable energy?
- Name some advantages and disadvantages of using renewable energy.
- In the process of saving energy, there are at least three important factors: reducing costs, generating sustainable jobs and protecting planet earth. How would you rank these factors in order of importance? Are these factors connected? How?
Materials
- 60 cards.
- 1 Brown, 1 Yellow and 1 Blue colors.
- Money Tokens (each represents 1 million dollars)
- 30 Coal tokens (can be any type of tokens, like mini-cubes)
- City Boards
- 1 Dice (for “Bus Tickets” problem)

Introduction
In this activity students will play a game in which they build power plants for their city paying for them and produce energy with a limit in generation of pollution. The important factors to consider when playing this game are: cost, maintenance, pollution and resources used. The goal is that students can understand these aspects mathematically from a conceptual point of view.

Game setup
Form teams of 2-3 students to have a total of 3 teams. Make exactly 3 teams, so that the card count works. Each team receives $4 (4 money tokens), one City Board, in which students will draw their power plants. Each team starts with an initial COAL PLANT. Have students color it with brown color. Each team represents a city. Shuffle all the 60 cards to form a single pile, face down.

Goal of the game
The game is played in 5 rounds (or 4 if you run out of time). The city that has produced the most energy at the end of the game wins. However there is a limit to the pollution caused by each city. Any city that pollutes more than this limit is eliminated from the game.

The 60 Cards
There are 3 types of cards:
- Power plants: these represent power plants built by the city. Each one has a cost that has to be paid to be built. Plants generate energy, in units of energy.
- Money cards: these cards represent money, in millions of dollars. So $1 = one million dollars.
- Modifier cards: these cards allow the teams to be more efficient during the game. Each effect is explained in each card.
Game Play

There are 5 rounds in a game (play only 3 or 4 if you are running short on time). Each round has two phases: 1) drafting phase and 2) execution phase.

1) Drafting phase: randomly deal 5 cards from the card pile to each team. The following method of choosing cards takes place:
* Each team chooses one card of the 5 to keep, puts it face down in his playing area, and passes the other 4 cards to the team on the right (make sure all teams choose their card at the same time to avoid confusion)
* Then teams do the same: each team chooses one card of the 4 just received, and passes the other 3 cards to the team on the right. Each team now has 2 cards face down in their playing area (never to be mixed with the cards received from the team to the left).
* Each team chooses one card of the 3 just received, and passes the other 2 cards to the team on the right.
* Each team chooses one card of the 2 just received, and discards the other card (in a discard pile, never enters the game).

At the end of this drafting procedure, each team will have exactly 4 cards, face down, in their playing area.

2) Executing phase:
Now all teams, at the same time, turn their 4 cards collected during the drafting phase, and do the following:

* Money cards: they represent money, which they keep and can use at any time
* Plant cards: they “install” each plant by drawing its shape and border in their city board and coloring it (brown for coal, yellow for sun, blue for wind). The pay the money immediately (initial cost).
* Modifiers: they execute their power when appropriate (sometimes discarding them, sometimes keeping them in their playing area for the whole game).

After all players have turned their cards and payed to install their new plants, the round is finished with the energy generation, money and pollution actions, as described in what follows.
Energy Generation: each team calculates the generated energy of their plants, according to the Energy Generation Table, and writes that total number in their city board.

- For coal plants, teams need to buy coal. The coal is finite and may be depleted. There are 30 units of coal and each coal plant needs 1 unit. Each package of 4 coal units cost $1 (bank gives no change). Each team can buy coal in this turn (take turns between interested teams, 1 package each turn), but no more packages than they need to operate their plants. They can keep some coal for next rounds if they don’t use it all. If a plant did not have a coal unit to operate it, that plant produces NO energy this round. Teams may decide not to operate a particular coal plant if they wish so (this helps reducing pollution).

- For solar plants, a die is rolled for all teams representing how “good” was the sun during the year and that determines the energy generated (see table).

- For wind plants, a die is rolled for all teams representing how “good” was the wind during the year and that determines the energy generated (see table).

Note that coal plants have a constant energy generated, whereas renewable energy plants have a variable one, that gets better every year because of technological advances.

Money: Each team gets half the energy units generated in money, rounded down. For example if a team generated 9 energy units, they receive $4 money (each $1 represents 1 million dollars, equivalent to 1 money token).

Pollution: Each team counts the number of coal plants that operated this round, and multiplies by 4: that is the number of units of pollution this year (each unit is 1 million tons of CO2). Note: some modifiers actually decrease the pollution of coal plants, so teams can take that into account.

If a team surpasses the 20 units pollution limit, the team is eliminated from the game.

After this, move on to the next round.
**Game End and scoring**

After round 5 ends (or whichever round you agree to), the game ends and scoring takes place using the following procedure:

- Mentors verify which teams polluted less than or up to 4 units. Those teams that polluted more than 20 units are eliminated from the game.
- From those teams that were not eliminated, each counts the total energy produced during the game. The team with the most energy generated wins the game.

In case of a tie, most money is the tiebreaker.

---

**Game Reference**

**Setup**

Shuffle the 60 cards to form a pile

Form 3 teams. Each gets:

- 1 City Board (draw 1 coal plant)
- $4 in money (4 money tokens)

**The Game**

5 rounds (or less if no time).

Each round:

- Drafting phase (a process in which each player gets 4 cards)
- Executing phase
  - Each team turns 4 cards
  - **Energy generation, money, pollution**

**Game End**

Team with most energy from those teams who polluted 20 or less, wins. Tiebreaker: money
Energy Generation Table

Instructions for each round: during the Executing Phase (energy generation part), roll 2 die (one for SOLAR, one for WIND): let X and Y be the different results. Results in this table are in terms of energy units. (Each unit is equivalent to 50 megawatts)

<table>
<thead>
<tr>
<th>Round</th>
<th>COAL PLANTS</th>
<th>SOLAR PLANTS</th>
<th>WIND PLANTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>10</td>
<td>X + 1</td>
<td>Y</td>
</tr>
<tr>
<td>2</td>
<td>10</td>
<td>X + 2</td>
<td>Y + 3</td>
</tr>
<tr>
<td>3</td>
<td>10</td>
<td>2X + 4</td>
<td>2Y + 4</td>
</tr>
<tr>
<td>4</td>
<td>10</td>
<td>3X + 4</td>
<td>3(Y + 3)</td>
</tr>
<tr>
<td>5</td>
<td>10</td>
<td>X² + 5X + 10</td>
<td>2Y² + 3Y + 5</td>
</tr>
</tbody>
</table>

Example: In round 4 a roll of Y = 2 was obtained for wind energy. Then EACH wind plant of each city obtains 3(2+3) = 15 energy units per plant (unless some modifying cards change this value).

Note: this table appears in each City Board, so that students can look at it at all times.

Finally, remember that this is a game to be played in a short time and as such provides an overly simplified version of reality, but it nevertheless illustrated the qualitative mathematical properties of the power plants, which is a very relevant topic in nowadays world.
2) ENERGY COSTS

- Before students start to work on the problems, explain the different concepts involved. It is strongly recommended that you ask the students to paraphrase the concept of kW.h (kilowatts hour) and ask them to give examples. One such example is: "if my gadget has a power wattage of 600, that means that it has a power of 0.6 kW, and so if it runs for 5 hours, it will use up a total energy of 0.6 x 5 = 3 kW.h. This is equivalent to having 3 gadgets each of power 1 kW, running for 1 hour".

- Make sure that students understand that to compute kW.h we need to know the time spent, and not just the power of the appliance. In other words, the energy spent depends on the time of use and not just of the power of the appliance.

- Notice that one thing that makes this problem interesting is that we didn't define power or energy independently in absolute physics terms, but rather we took a relational approach. That is, we defined 1 kW as a fundamental unit of power, and said that more power causes more energy in a proportional way. Then we defined the kW.h as a fundamental unit of energy in relation to 1 kW, but we never talked about Joules for energy. This relational set-up may be somehow abstract but it is an excellent opportunity to provide mathematical thinking and conceptual knowledge, and to promote using ratios as a tool (as we have done in previous meetings), now in a definite scientific context.

- Beyond the energy physic concepts and the math operations involved in the activity, it is important that you as a mentor send a message that math can help us save energy and money by being able to compute costs of electricity and that we can take action to save energy, which is important, environmentally speaking.
3) GENERATING ENERGY

- Have students in each team pick the name of their city and fantasize a little bit about it. This may increase motivation which helps learning, and also makes the game more fun.

- It is very important to explain the rules of the game in a non-mechanical way, connecting to reality and such that they make sense. For example, when you explain the 20 or less pollution rule, you can bring up the topic of climate change and specify that the limit pollution is important for society. When you explain the variability in the energy for renewable plants, you can explain that this is due to variability in weather conditions, etc.

- While you explain the rules of the game to your students, spend some time to analyze the Generating Energy table in which the energy units for coal, solar and wind plants are established. This table is an interesting representation that combines variational (algebraic) and statistical (data) information, as it has different types of data, 5 different rounds, and several algebraic expressions to compute some of the energy units. By asking questions and guiding your students, they should conclude interesting things such as:
  
  - The energy for coal is constant, always 10 units of energy.
  - Renewable energy (solar and wind) starts way worse than coal (for example in round 1 the max is 7 and the min is 1), but then it gets better and better due to technological advances. In the last round, the maximum possible number of energy units for wind is 95.
  - The reason why renewables are variable is that weather conditions are uncertain. Each round represents a year, and so there may be years in which the sunshine was great, whereas in others the sunshine may be quite poor.
3) Generating Energy

- As you play the game, ask questions and guide the students to discover the pros and cons of each type of plant, and explain that the same is true in real life, just that with other numerical values. For instance:
  - Coal is good because it is more efficient, although as technology advances, wind and solar plants will catch up and be more efficient.
  - Coal is bad because it pollutes a lot, and that may destroy the planet.
  - Coal is bad because it uses finite resources, so at some point in the near future we will run out of the prime materials.
  - Renewables are good because they use wind and sun, which are virtually infinite resources, so we won’t run out.
  - Renewables are good because the pollution is virtually zero (you can explain that in this game is 0, but in real life there is some pollution due to installation and other factors, but it is minimal compared to fossil fuels such as coal).
  - Renewables are bad because they are inefficient compared to coal, but as technology advances, they get better and better.
  - Renewables are bad because there is variability in weather conditions that may affect the power plant’s performance. For example if the wind is poor in some time of the year, wind plants will perform poorly.

Note: you may explain that coal is just an example of fossil fuel sources of energy such as gas and oil, whereas wind and sun are just examples of renewable energy such as biofuel or biomass.
Student’s Workbook
(WHITE PAPER)
6 pages

128 Copies, 2-sided, stapled
Meeting 7 Fall 2017

Energy
November 15th

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Teaching Tips

www.math.uci.edu/mathceo
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<td>15</td>
</tr>
</tbody>
</table>

Carl has a Coffee Maker of wattage of 1000 and a Microwave oven of wattage 1500. During an 8-day period, he used the Coffee Maker all days, an average of 30 minutes every day, and the Microwave all days, an average of 15 minutes every day.

Which appliance delivers more power? Which appliance used more energy during the 8-day period? By how much?
In Santa Ana, the cost of energy is of US$0.12 per kW.h (kilowatt hour).

For example, if an appliance of Wattage 1000 runs for 4 hours, the kW.h spent is equal to 4 kW.h, and so you will pay 48 cents: $1000 \times 4 \times 0.12 = \text{US$ 0.48}$

(A kW.h is a unit of energy equivalent to 1 kW of power sustained for a complete hour).

If an appliance of wattage 500 runs for 40 hours, how much money do you need to pay for the energy consumed?

An appliance of wattage 600 was used during a 12-day period. If a total of US$0.432 was spent, for how many minutes daily on average was the appliance used?
Manipulatives

You don’t have to print or cut these manipulatives. We will have these at the meeting.

- **Page 33: City Boards**
  - 60 copies of each page, yellow, 1-sided, non-stapled. 3 per table.

- **Pages 34-43: Cards**
  - 20 copies, 1-sided, non-stapled, pink color, cut and assemble 20 kits, each kit having a total of 60 cards (those appearing in the pages). Clip each kit with a clip or inside a plastic bag. 1 kit per table.
CITY BOARD

CITY: __________________________________

<table>
<thead>
<tr>
<th>Round</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tbody>
<tr>
<td>Pollution</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

City with most total energy wins the game, but your total pollution must be 20 or less, otherwise you are eliminated.

Energy Generation Table

<table>
<thead>
<tr>
<th>Round</th>
<th>COAL PLANTS</th>
<th>SOLAR PLANTS</th>
<th>WIND PLANTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>10</td>
<td>X + 1</td>
<td>Y</td>
</tr>
<tr>
<td>2</td>
<td>10</td>
<td>X + 2</td>
<td>Y + 3</td>
</tr>
<tr>
<td>3</td>
<td>10</td>
<td>2X + 4</td>
<td>2Y + 4</td>
</tr>
<tr>
<td>4</td>
<td>10</td>
<td>3X + 4</td>
<td>3(Y + 3)</td>
</tr>
<tr>
<td>5</td>
<td>10</td>
<td>X² + 5X + 10</td>
<td>2Y² + 3Y + 5</td>
</tr>
</tbody>
</table>

Before the game starts, you get 1 coal plant for free. Draw it anywhere in the board (in any orientation) and color it brown.

Coal Brown Area: 3  Solar Yellow Area: 4  Solar Blue Area: 11
MEETING 07 - MANIPULATIVES
ACTIVITY 3) GENERATING ENERGY

CARDS

COAL PLANT
Cost: $5
Pollution: 4 million tons CO2

SOLAR PLANT
Cost: $8
Pollution: 0 million tons CO2

WIND PLANT
Cost: $7
Pollution: 0 million tons CO2

COAL PLANT
Cost: $4
Pollution: 4 million tons CO2

SOLAR PLANT
Cost: $9
Pollution: 0 million tons CO2

WIND PLANT
Cost: $8
Pollution: 0 million tons CO2
COAL PLANT
Cost: $5
Pollution: 4 million tons CO2

SOLAR PLANT
Cost: $8
Pollution: 0 million tons CO2

WIND PLANT
Cost: $7
Pollution: 0 million tons CO2

COAL PLANT
Cost: $4
Pollution: 4 million tons CO2

SOLAR PLANT
Cost: $9
Pollution: 0 million tons CO2

WIND PLANT
Cost: $8
Pollution: 0 million tons CO2
MEETING 07 - MANIPULATIVES
ACTIVITY 3) GENERATING ENERGY

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<th>PLANT</th>
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<tr>
<td>Wind Plant</td>
<td>$7</td>
<td>0 million tons CO2</td>
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MEETING 07 - MANIPULATIVES
ACTIVITY 3) GENERATING ENERGY

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</tr>
<tr>
<td>WIND PLANT</td>
<td>$8</td>
<td>0 million tons CO2</td>
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</tbody>
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**Generating Energy**

**Coal Plant**
- Cost: $5
- Pollution: 4 million tons CO₂

**Solar Plant**
- Cost: $8
- Pollution: 0 million tons CO₂

**Wind Plant**
- Cost: $7
- Pollution: 0 million tons CO₂
Collect $2 for each COAL PLANT you have installed
Use this card once at any time, and discard it after you collect the money

Collect $2 for each WIND PLANT you have installed
Use this card once at any time, and discard it after you collect the money

Collect $2 for each SOLAR PLANT you have installed
Use this card once at any time, and discard it after you collect the money
Collect $2 for each **COAL PLANT** you have installed

Use this card once at any time, and discard it after you collect the money

Collect $2 for each **WIND PLANT** you have installed

Use this card once at any time, and discard it after you collect the money

Collect $2 for each **SOLAR PLANT** you have installed

Use this card once at any time, and discard it after you collect the money
<table>
<thead>
<tr>
<th>CARD</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CARD</td>
<td>Reduce the pollution of each COAL PLANT by 1 unit. Keep this card in your playing area until the end of the game.</td>
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<td>CARD</td>
<td>Add +1 to die roll for WIND PLANT (energy phase). This effect only applies to your city. Keep this card in your playing area until the end of the game.</td>
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<tr>
<td>CARD</td>
<td>Add +1 to die roll for SOLAR PLANT (energy phase). This effect only applies to your city. Keep this card in your playing area until the end of the game.</td>
</tr>
<tr>
<td>CARD</td>
<td>Replace one COAL PLANT with one SOLAR or WIND PLANT. (Cross-out the COAL PLANT from your City Board) Use this card once at any time, and discard it after.</td>
</tr>
</tbody>
</table>
MEETING 07 - MANIPULATIVES
ACTIVITY 3) GENERATING ENERGY

CARDS

Get $4 if your city was the one polluting the least this round (including ties).
Keep this card in your playing area until the end of the game.

Get $4 if your city was the one polluting the least this round (including ties).
Keep this card in your playing area until the end of the game.

Choose one COAL PLANT. During the rest of the game, operate it without using units of coal.
Keep this card in your playing area until the end of the game.

Your city invested in environment. Reduce your accumulated pollution by 2 units.
Use this card once at any time, and discard it after.

Your city invested in environment. Reduce your accumulated pollution by 2 units.
Use this card once at any time, and discard it after.

Replace one SOLAR PLANT with one WIND PLANT or vice versa.
(Cross-out the removed PLANT from your City Board)
Use this card once at any time, and discard it after.
Student Survey
(Pink paper)
128 copies
2-sided
Problem 1
(Take at the end of Activity 2)

(A) Jeff bought pencils and books at a rate of 4 : 3. If he bought a total of 42 items (between pencils and books), how many pencils did he buy?

Draw a bar model and solve the problem:

Answer: Jeff bought _______ pencils

(B) Carl has a Heater of wattage of 4000 and a Dryer of wattage 3000. He used the Heater for 5 hours and the Dryer for 8 hours.

Which appliance used more energy and by how much?
First AND Last Name: ________________________   _______________________________      Table Number: _______    Lathrop (   )    Villa  (   )

Questions:
1) How enjoyable were today’s tasks? 1= not at all enjoyable  2  3= somewhat enjoyable  4  5= very enjoyable
2) How competent did you feel on today’s tasks? 1= not competent at all  2  3= somewhat competent  4  5= very competent
3) How did you feel while solving today’s tasks? 1= not pressured at all  2  3= somewhat pressured  4  5= very pressured
4) How important was for you to do well on today’s tasks? 1= not important at all  2  3= somewhat important  4  5= very important
5) How close do you feel to your mentor at Math CEO? 1= not close at all  2  3= somewhat close  4  5= very close
6) How close do you feel to your peers at Math CEO? 1= not close at all  2  3= somewhat close  4  5= very close

Feedback for your mentor: ________________________   _______________________________

3 words to describe Math CEO ________________________________   _____________________________    ________________________________

2 THINGS WHICH I LEARNED TODAY

2 THINGS THAT I FOUND INTERESTING

I QUESTION THAT I STILL HAVE

Clean your table when you finish, return the dry-erase markers, pick up your trash and take your belongings. Thank your mentor!

Thanks for your responses!
Meetings Report
(Blue paper)
Dear leader mentor,

Please complete this survey about each of the students at your table. Circle the number that better reflects how you feel. We really value your input. THANK YOU for your thoughtful answers, and for your amazing contribution to Math CEO.

<table>
<thead>
<tr>
<th>STUDENT'S FIRST NAME: ___________________  LAST NAME: ______________________</th>
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<tbody>
<tr>
<td>Compared to his/her peers, how good was this student at solving today’s math activities?</td>
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