

3-5 At-Home Learning Resources

(Blue Packet)

Week #2

The Richland School District cares deeply about the well-being of our students and families. We highly encourage our students and families to set a daily routine that includes the following:

For our elementary families:

- Read daily with your child
- Play family games (board games, cards, puzzles, charades, pictionary, etc.)
 - Engage in an outside activity
 - Cook/bake with your child
- Maintain relationships with your child's teacher

These supplemental activities, readings, and other resources are available to students and families to continue learning and exploring while schools are closed in response to the novel coronavirus.

Students are not required to complete and/or turn in any assignments nor will any of these materials be used to assess students academically. Please feel free to use these optional resources as needed. Additional resources are available at:

<https://www.rsd.edu/coronavirus/learning-resources>.



Comprehension

C.025

Text Analysis

Fiction and Nonfiction Find



Objective

The student will identify fiction and nonfiction text.



Materials

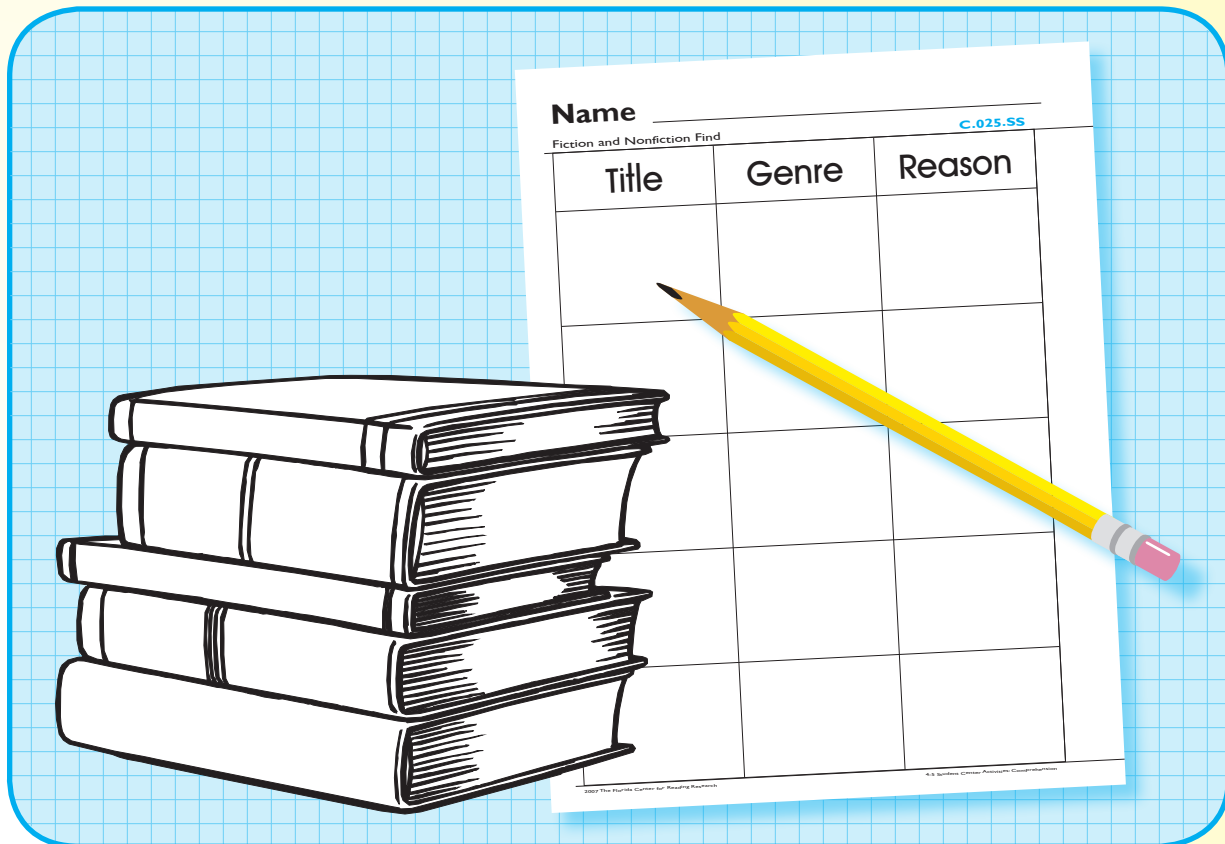
- ▶ Books
A variety of fiction and nonfiction books or texts.
- ▶ Student sheet (Activity Master C.025.SS)
- ▶ Pencil



Activity

Students sort books or texts into fiction and nonfiction.

1. Provide the student with books or texts and a copy of the student sheet.
2. The student selects a book, reviews it, and determines if it is fiction or nonfiction.
3. Writes the title of the book, genre (i.e., fiction or nonfiction), and the reason for the designation on the student sheet.
4. Continues until all the books or texts are reviewed.
5. Teacher evaluation



Extensions and Adaptations

- ▶ Discuss book or text designations with a partner.
- ▶ Sort books or texts by other genres and subgenres (e.g., biography, poetry, fantasy, folktale), write titles (Activity Master C.005.AM3), and place under correct header (Activity Master C.025.AM1a - C.025.AM1b). Write any needed headers (Activity Master C.008.AM3).

Name _____

Fiction and Nonfiction Find

C.025.SS

Title	Genre	Reason

Comprehension

C.025.AM1a

Fiction and Nonfiction Find

fiction

header

nonfiction

header

autobiography

header

biography

header

fantasy

header

folktale

header

header cards



Comprehension

Fiction and Nonfiction Find

C.025.AM1b

poetry

header

mythology

header

historical
fiction

header

mystery

header

science fiction

header

fairy tale

header

header cards



Questions to Ask Before, During, and After Reading

These are questions to help engage students in discussions and conversations about reading. These questions are just suggestions and other questions can be added to this list based upon the type of reading students are involved in.

Before Reading

- What is the title of the book or text?
- What does this title make you think about?
- What do you think you are going to read about? (Make a Prediction)
- Does this remind you of anything?
- Are you wondering about the text or do you have any questions before reading?
- Skim through the article. Do any pictures, key words, and/or text features stand out to you?

During Reading

- What is happening so far?
- What does the word _____ mean on this page?
- What do you think the author is trying to communicate in this part?
- What do you think was important in this section? Why do you think it was important?
- What can you infer from this part of the text?
- Where is the story taking place?
- Who are the characters so far?
- What do you think will happen next?
- What does this part make you think about?
- What questions do you have?
- What words help you visualize what the author is saying?
- Is there a word that you struggled with? What is the word? Let's break the word into parts and look at context clues.

After Reading

- What was this text about?
- What was the main idea? What details from the text helped you determine the main idea?
- What did you learn from this text?
- How did the author communicate his/her ideas?
- What does this text remind you of?
- What was your favorite part and why?
- Did this text have a problem? If so, what was the problem and what was the solution?
- What is your opinion about this text? What are some parts that helped you make that opinion?
- What are some questions you still have about the text?
- Does this text remind you of other texts you have read? How are they alike and/or different?
- What is a cause and effect from the text you read?

What's the Forecast?

Cross-Curricular Focus: Earth Science



The weather **forecast** predicts what the temperature and air conditions will be in the near **future**. There is a wide variety of types of weather. The weather can be sunny or stormy. It can be warm or cool. It also can be rainy, cloudy or windy. Sometimes, weather is severe. A blizzard, a thunderstorm or a hurricane may happen quickly. When we get information ahead of time, we can prepare for it. Being prepared helps us stay safe.

A meteorologist is a person whose job it is to forecast the weather. There are many tools available to help the meteorologist do his job. A common tool for getting an accurate **measurement** of the temperature is a thermometer. A high temperature probably means plenty of **sunshine** for everyone.

In rainy weather, a meteorologist uses a rain gauge. A rain gauge gives **numerical** data about how much rain is falling **outdoors**. After it rains, you may be able to see a **rainbow**. A rainbow appears when the sun comes out and there is still rain in the air.

Wind brings us weather. It blows clouds from one place to another. It is helpful to know which direction the wind is blowing. A wind vane provides this information. Knowing the wind direction helps a meteorologist know what weather is coming.

Weather forecasts are not always right. As our knowledge about weather gets better, the forecasts become more accurate.

Name: _____

Answer the following questions based on the reading passage. Don't forget to go back to the passage whenever necessary to find or confirm your answers.

1) What is a weather forecast?

2) What is a person whose job it is to forecast the weather called?

3) Name one weather tool and tell what it is used for.

4) What is your favorite kind of weather? Why?

5) Do you think the job of a meteorologist is difficult or easy? Explain your thinking.

Magnetic Attraction

Cross-Curricular Focus: Physical Science



An object that attracts metals, especially iron, is called a **magnet**. The area near the magnet where it has enough power to attract things is called its magnetic field. The farther away from the magnet an item is, the weaker the magnetic field is. When it is weak, it is less likely an object will become attracted to the magnet.

Magnets can be either **permanent** or **temporary**. A permanent magnet stays magnetized for a long time. A temporary magnet loses its magnetism after only a short time. You can even turn something made out of iron into a temporary magnet by rubbing it against a permanent magnet. The more you rub, the stronger your temporary magnet gets. However, the effects will wear off over time.

The two ends of the magnets are called **magnetic poles**. The poles are found at the ends of bar magnets and the tips of the horseshoe magnets. They are the strongest parts of the magnet. Each magnet has a north pole and a south pole. Opposite poles attract, or pull toward each other. Poles that are the same repel, or push away from each other. A north pole and a south pole will pull toward each other. Two north poles will push away from each other. The same happens with two south poles. When you hold magnets, you can actually feel the push and pull effects of magnetism.

A special kind of temporary magnet uses electricity to create a magnetic field. It is called an **electromagnet**. An electromagnet can be an extremely strong magnet. However, it only acts like a magnet when it has electricity. A stronger electrical current will produce a stronger magnet. Unlike other magnets, an electromagnet can be controlled by a switch. When the switch turns the electrical current off the electromagnet loses its magnetism. Whatever the electromagnet was holding drops to the ground. We use this technology to operate large cranes that lift heavy metal objects, such as cars.

Electromagnets are also used to make motors run in small appliances. Combining regular magnets and electromagnets makes it possible for electrical energy to be turned into energy of motion.

Name: _____

Answer the following questions based on the reading passage. Don't forget to go back to the passage whenever necessary to find or confirm your answers.

1) Explain the difference between a temporary magnet and a permanent magnet.

2) Would two north poles attract each other or push away from each other?

3) What is different about an electromagnet?

4) What do we use electromagnets for?

5) What does attract mean when speaking about magnets? _____

Water, Water Everywhere

Cross-Curricular Focus: Earth Science



Water is probably Earth's most precious resource. After all, we can't live without it. Earth is the only known planet to have water. Our entire planet is covered in water, with little pieces of land called continents here and there. Our oceans are not the only places we have water. It is also present under the ground and as vapor in the air. Clouds formed by the vapor ensure that water falls back down to Earth as rain, sleet, snow or hail.

So with so much water all around us, why do we hear so much about the need to conserve water? It has to do with the water's salinity, or saltiness. Ocean water has too much salt in it for us to drink. Much of the water that falls back to Earth in one form or another becomes **runoff**.

It travels some distance over land before making its way back to one of Earth's oceans. As it travels over land, the water picks up salts and minerals from the rocks and soil and washes them into the ocean. The deposits have built up over many years. That is why ocean water is so salty.

Approximately 97% of Earth's water is salt water. The process of **desalination**, or removing salt from water, is expensive. That leaves only about 3% that is freshwater for meeting the needs of people, plants and animals. This is why there is concern for protecting this rare and critical resource. Unfortunately, only about a third of our freshwater is even available for us to use. The rest is frozen solid in glaciers, in the snow on high mountaintops and in the polar ice caps. So the end result is that we have only about 1% of all the water on Earth that we can use.

The freshwater we use comes from surface water and **groundwater**. Surface water, just as it sounds, is water we can see in ponds, rivers, lakes and streams. Groundwater is water that seeps down into the ground and collects in the spaces between rocks and soil underground. You can find water just about anywhere on Earth if you dig far enough into the ground.

It is important to protect our water supplies from pollution. Once the water becomes polluted, it can be difficult or even impossible to clean. Chemicals, like cleaning supplies, paints and other toxins, can seep into the ground and make the water unusable. People must dispose of their waste products appropriately so we will have plenty of freshwater to go around.

Name: _____

Answer the following questions based on the reading passage. Don't forget to go back to the passage whenever necessary to find or confirm your answers.

1) With so much water all around us, why is there so little water for us to use?

2) What are the four forms that water takes when it returns to Earth from the clouds?

3) What is the main idea of this passage?

4) Where is groundwater found?

5) What type of substance can seep into groundwater and make it unusable?

Some parents are fine with texting their kids instead of talking to them

By USA Today, adapted by Newsela staff on 04.29.19

Word Count **525**

Level **580L**



Texting at home may be a prelude to a deeper conversation. However, a dependence on devices may also impede learning social interaction and how to read body language, experts say. Photo by: FatCamera/Getty Images

Dinner is ready. Parents have a choice. They can yell out to kids to announce it. Today, though, many are texting their kids instead.

Is this good or bad? In texting kids at home, are parents encouraging kids to stay addicted to smartphones?

Some parents shared their opinions. Many are cool with same-home texting.

Wendy Anton is a Michigan nurse. She texts with her kids at home. The adults text each other too, she says.

Yelling may actually have negative effects anyway, says Dr. Pamela Rutledge. She is an expert on how people use technology and how it affects them. She says yelling covers up details that are heard in a regular talking voice. There's no "benefit of adding an emoji for clarification," she says.

Humans respond without even thinking to certain behaviors, she says. Yelling makes people defend themselves right away. It might make you feel like you are in trouble.

Trying To Avoid Trouble

Dr. Nancy Mramor is a psychologist in Pennsylvania. She is an expert in how people behave. She says that, actually, we often turn to technology when we think we are in trouble. People of all ages do this. We want to avoid long conversations, she says.

Texting can sometimes lead to longer talks.

Tamra Forsman is a mother of three. She lives in Washington state.

She often lets her kids communicate in "their way" – text – first. Then she does it her way – conversation. This hopefully strikes a balance, she says.

"Communication is so important, especially in the teen years," Forsman says. "I am thankful for a text because a lot of teens would never text their mom."

Kelli Jones Geiger is a mom in Houston. She agrees. Texting allows her to carefully craft her words before "blurting them out."

Kids may also see texting as a more comfortable way to start certain conversations.

Short Messages Have Replaced Conversations

Amy Wing lives in Chandler, Arizona. Her 12-year-old daughter Erin explains to her mother why she texts her. "I text you when there's something difficult for me to talk about straight to your face, or if I'm tired or doing something, or if I'm with friends and don't want to go and talk to you. If you call me to come talk to you, I'll go. But if I need something and it doesn't have to be straight away, I'll text you."

Still, some parents are against the practice.

Katie May is a mother of six. She does not allow texting in the house. Instead she requires talking to each other in real life.

So, we often talk by text instead of in person. Will this create lasting brain problems?

Today, says Mramor, people depend on phones. Phones let us respond quickly. Often it is with short messages. She says this is a shame. Instead, we could be "really talking something through." By having conversations, she says, we learn social skills. We learn how to read others' reactions.

Rutledge does not agree. She says things haven't changed all that much. Before texting, kids still did not always "happily come downstairs" to chat in person, she said.

Quiz

- 1 One main idea of the article is that some parents think it is OK to text their kids instead of talking to them.
Which key detail from the article supports this MAIN idea?
- (A) Yelling may actually have negative effects anyway, says Dr. Pamela Rutledge. She is an expert on how people use technology and how it affects them.
 - (B) Kelli Jones Geiger is a mom in Houston. She agrees. Texting allows her to carefully craft her words before "blurting them out."
 - (C) Katie May is a mother of six. She does not allow texting in the house. Instead she requires talking to each other in real life.
 - (D) Today, says Mramor, people depend on phones. Phones let us respond quickly. Often it is with short messages.
- 2 What is the MAIN idea of the section "Trying To Avoid Trouble"?
- (A) Some people say texting helps them to communicate better.
 - (B) Some people yell to talk to their kids instead of texting.
 - (C) The short messages in texting let people respond quickly.
 - (D) The technology behind texting has changed over time.
- 3 What information will readers find in the introduction [paragraphs 1-6]?
- (A) reasons why some parents dislike texting
 - (B) reasons why teens are texting more now
 - (C) how texting at home compares with yelling
 - (D) how many people now text instead of talking
- 4 What does the section "Short Messages Have Replaced Conversations" show the reader?
- (A) ways that texting affects family dinner conversations
 - (B) reasons why technology can get people into trouble
 - (C) problems caused by yelling at kids instead of texting them
 - (D) different opinions about texting instead of talking in person

Many species take turns communicating with each other

By Smithsonian.com, adapted by Newsela staff on 08.07.18

Word Count **662**

Level **840L**



Elephants communicate in low rumbles, listening for the resulting vibrations in the ground with their feet. Photo by: Brian Snelson, Flickr

When people talk to each other, they usually take turns. They know when to speak and when to listen. We consider it disrespectful to interrupt. This kind of conversation is often considered a human trait. Many believe it separates us from the rest of the animal kingdom.

However, studies show that back-and-forth conversations happen among animals, too.

The conversations might involve the delicate hand gestures of chimpanzees. Whale songs travel thousands of miles through lonely oceans. Some conversations exist only in the brief flashes of light between fireflies in the dark.

A recent review of several studies shows a common pattern in conversations. Animals, too, seem to know when to speak and when to listen. This is true even in exchanges that are non-verbal, meaning they do not use sounds.

The review was published last month in a scientific journal. It looked at more than 300 studies of animals including mammals, birds, insects and frogs who practice turn-taking behavior.

Back-And-Forth Exchanges

A great number of animals use call and response. This is similar to how humans communicate. For example, marmosets, a type of small monkey, often exchange calls to locate each other and figure out whether they know one another. Dolphins chatter back and forth while coordinating attacks on prey.

Many of these forms of communication are sound-based. Frogs make croaking sounds. Insects make crackling sounds. Other animals have more creative ways to communicate. Young bonobos, a type of great ape, let their parents know they want to be carried with arm gestures. Birds, insects and frogs get their messages across through colorful displays, and the elephants feel vibrations through the earth when they use low rumbles to find each other.

These might be less traditional ways of communication. Still, they are similar to turn-taking in human exchanges. For example, elephants wait their turn before responding to rumbles.

Conversations cannot be studied like fossils. Therefore, learning how conversations have evolved, or changed over many, many years, can be tricky. Robin Kendrick is a language professor and co-author on the review. Kendrick thinks making comparisons between humans and animals taking turns is important. It gives us clues about how humans came to have this trait.

He says we know little about how human language began. We need more study on the subject.

Researcher Says Study Has Value

Thom Scott-Phillips studies science and was not involved in the review. He says Kendrick and his coauthors' paper has value. He accepts that many different animals use back-and-forth exchanges to communicate.

However, he has a warning. Scott-Phillips says "we need to be careful what conclusions we draw." He says similar behavior doesn't always mean the brains and bodies of different animals work the same ways.

Kendrick singles out another trait worth comparing, the silence between exchanges. In human conversation, we generally pause for 200 milliseconds before answering. Kendrick says a longer or shorter pause tends to signal something is wrong. An example would be a delayed response from a governor when questioned about wrongdoing. The opposite would be a lightning quick "it wasn't me" from a kid with a bat near a broken window.

Is This Loud Enough?

The idea of turn-taking might bring to mind a picture of well-mannered animals. Kendrick stresses this isn't always the case. Animals can be like reporters fighting to get their question answered. Barn owl chicks try to outdo each other by chirping louder or more quickly to attract favor from their mothers during feeding.

These cases of overlapping signals can be seen as breaking the rule, says Kendrick. He believes it highlights the value of turn-taking in general.

Kendrick sees a problem among people who study turn-taking. They do not communicate well themselves. A person studying turn-taking in one kind of animal fails to talk to people studying

turn-taking in other animals. Kendrick says a goal of the review is to bring together the separate studies on turn-taking, allowing scientists to do more comparisons between animals.

Quiz

1 In which of these scenarios would call and response be most useful?

- (A) fighting with its sibling
- (B) looking for its mother
- (C) playing with its friend
- (D) screaming at a predator

2 Read the selection below from the introduction [paragraphs 1-5].

When people talk to each other, they usually take turns. They know when to speak and when to listen. We consider it disrespectful to interrupt. This kind of conversation is often considered a human trait. Many believe it separates us from the rest of the animal kingdom.

However, studies show that back-and-forth conversations happen among animals, too.

Which sentence from the selection explains why it is wrong for people to think that only humans take turns talking to each other?

- (A) When people talk to each other, they usually take turns.
- (B) This kind of conversation is often considered a human trait.
- (C) Many believe it separates us from the rest of the animal kingdom.
- (D) However, studies show that back-and-forth conversations happen among animals, too.

3 How does animal communication improve chances of survival?

1. *by coordinating an attack on prey*
2. *by eating prey before a friend can*
3. *by letting predators know their location*
4. *by figuring out the locations of predators*

- (A) 1 and 3
- (B) 2 and 3
- (C) 1 and 4
- (D) 2 and 4

4 Read the section "Back-And-Forth-Exchanges."

Which sentence from the section explains one reason why it has been difficult for scientists to research how communication between animals has changed over the years?

- (A) A great number of animals use call and response.
- (B) Conversations cannot be studied like fossils.
- (C) He says we know little about how human language began.
- (D) We need more study on the subject.

5 In which scenario might animals talk over each other instead of taking turns?

- (A) a human asking an important question
- (B) a male bird listening for a female mate
- (C) a prairie dog warning about a predator
- (D) a mother penguin trying to find her chick

6 The word "exchanges" is essential to understanding the article.

Which phrase from the article BEST explains what "exchanges" means?

- (A) back-and-forth conversations
- (B) review of several studies
- (C) responding to rumbles
- (D) making comparisons

7 The new baseball stadium will be lit up for 24 hours to be used as a practice space for players.

Which of the following animals would MOST likely be affected?

- (A) animals that communicate using light
- (B) animals that communicate using vibrations
- (C) animals that communicate using sound
- (D) animals that communicate using touch

8 Read the selection below from the section "Is This Loud Enough?"

Kendrick sees a problem among people who study turn-taking. They do not communicate well themselves. A person studying turn-taking in one kind of animal fails to talk to people studying turn-taking in other animals.

Which answer choice uses the word "fails" in the same way it is used in the selection above?

- (A) If she fails the test, she will have to do the work over again.
- (B) Sometimes, she fails at first when trying new skateboard tricks.
- (C) If that business fails, it will be because of a poor location.
- (D) He scores high on tests, but he fails to tell people how well he is doing.

Writing Ideas 3-5 Elementary Week #2

Students can compose sentences and/or paragraphs to respond to the prompts and ideas below. This will vary depending on their age/grade level.

Narrative

- Write about a time when you helped another person out. How did you help this person? Include descriptive details to describe your actions, thoughts, and/or feelings and provide clear event sequences. Provide an introduction and conclusion.

Opinion/Argument

- Write an opinion piece on why you would recommend a certain book or story. Be sure to include the title, clearly state your opinion, and provide a conclusion related to your opinion. Use details from the text to support your opinion.

Informational/Explanatory

- What are some measures that kids can take to keep themselves safe and healthy? Write a paper providing information about this topic. Clearly introduce your topic and add enough facts and/or details so your reader can learn what they can do to stay safe and healthy. Provide a concluding statement that is related to the information you provide.

Writing in Response to Reading Bingo

Complete the Bingo board by engaging in various writing ideas from this week's reading selections. Try to get 3-in-a row!

Pick an area of the United States or an area in another country and research the weather for that area. Write an informative paper describing the region or area you selected and the weather that they would experience in a typical year or season.	Write a poem, story, or song about water. Draw an illustration or comic strip to go with it.	Select various vocabulary words from the reading you did and use those words to write a poem, song, or play!
After reading the article Some Parents are Fine with Texting Their Kids Instead of Talking to Them , do you think it is better to talk face-to-face or to text? Write an opinion piece stating your opinion and support it with details from the text and other resources.	WRITER'S CHOICE	Magnets are used in products all around us! Do some additional research on magnets and write an informative paper about what you learned. Be sure to Introduce your topic, use details from your research, and provide a conclusion.
Pick something from the reading selections that you would like to learn more about. Research that topic and write an informational/explanatory piece about what you learned.	Create a Prezi, PowerPoint, Poster, and/or infographic about weather, magnets, communication, or water. Present what you learned to a family member!	Write about how the two reading selections Some Parents are Fine with Texting Their Kids Instead of Talking to Them and Many Species Take Turns Communicating with Each Other are similar and/or different?







English Language Learners 3-5

Reading

- Read the poem “Five Little Seeds” by yourself or with someone in your family.
- Think about any gardens that you’ve seen.
- Highlight or circle any words in the poem that are new to you.

Speaking

- Read the poem aloud to someone in your family.
- Talk about gardens with someone in your family. What kinds of plants can be grown in a garden?
- Ask someone in your family about the words that are new to you.

Listening

- Have someone else in your family read the poem aloud to you.
- Close your eyes while you listen to the poem and imagine pictures in your mind that match the words in the poem.

Writing

- In the box under the poem, illustrate a picture of a garden.
- Make a list of what you would like to grow in a garden.

Five Little Seeds

Five little seeds,
Five little seeds,
Three will make flowers,
And two will make weeds.

Out comes the sun,
Down comes the shower.
And up comes the three
Pretty pink flowers.

Under the leaves,
And under the snow,
Five little seeds are
Waiting to grow.

Out comes the sun
That every plant needs,
And up comes two
Funny old weeds.

Illustrate a picture of a garden

If you had a garden, what would you grow? Make a list of what you would like to grow in a garden.

5x5 Magic Square

1. Write the numerals 1-25 on small squares of paper and cut them out.
2. Move the numbers around the spaces on the board so that the sum of each row, column, and main diagonal equals 65.
3. Record your work.

The magic number is 9.0

		3.6
1.8	3.0	

Decimal Magic Squares

Materials: Decimal Magic Squares

1. Select a Magic Square. Fill the empty spaces with decimal numbers so that the sum of the numbers on each row, column and main diagonal is equal to the given number. Show your work.
2. Repeat with a different Magic Square.
3. Create your own Decimal Magic Square for a classmate to solve.

The magic number is 9.0

		3.6
1.8	3.0	

The magic number is 12.6

		4.8
3.6	6.6	

The magic number is 39.3

14.9	10.7	
		11.3

The magic number is 15.3

6.9		
	5.1	6.3

Activity 4

Card Flip Magic—*Error Detection & Correction*

Summary

When data is stored on a disk or transmitted from one computer to another, we usually assume that it doesn't get changed in the process. But sometimes things go wrong and the data is changed accidentally. This activity uses a magic trick to show how to detect when data has been corrupted, and to correct it.

Curriculum Links

- ✓ Mathematics: Number Level 3 and up. Exploring computation and estimation.
- ✓ Algebra Level 3 and up. Exploring patterns and relationships.

Skills

- ✓ Counting
- ✓ Recognition of odd and even numbers

Ages

- ✓ 9 years and up

Materials

- ✓ A set of 36 “fridge magnet” cards, coloured on one side only
- ✓ A metal board (a whiteboard works well) for the demonstration.

Each pair of children will need:

- ✓ 36 identical cards, coloured on one side only.

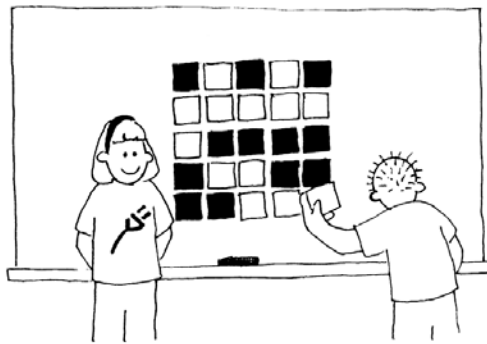
The “Magic Trick”

Demonstration

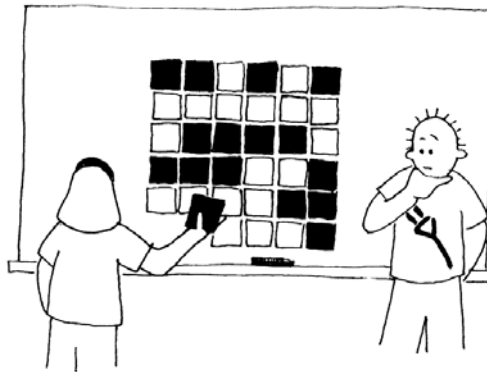
Here’s your chance to be a magician!

You will need a pile of identical, two-sided cards. (To make your own cut up a large sheet of card that is coloured on one side only). For the demonstration it is easiest to use flat magnetic cards that have a different colour on each side—fridge magnets are ideal.

1. Choose a child to lay out the cards in a 5×5 square, with a random mixture of sides showing.



Casually add another row and column, “just to make it a bit harder”.



These cards are the key to the trick. You must choose the extra cards to ensure that there is an even number of coloured cards in each row and column.

2. Get a child to flip over one card only while you cover your eyes. The row and column containing the changed card will now have an odd number of coloured cards, and this will identify the changed card.

Can the children guess how the trick is done?

Teach the trick to the children:

1. Working in pairs, the children lay out their cards 5×5 .
2. How many coloured cards are there in each row and column? Is it an odd or even number? Remember, 0 is an even number.
 3. Now add a sixth card to each row, making sure the number of coloured cards is always even. This extra card is called a “parity” card.
 4. Add a sixth row of cards along the bottom, to make the number of cards in each column an even number.
 5. Now flip a card. What do you notice about the row and column? (They will have an odd number of coloured cards.) Parity cards are used to show you when a mistake has been made.
 6. Now take turns to perform the ‘trick’.

Extension Activities:

1. Try using other objects. Anything that has two ‘states’ is suitable. For example, you could use playing cards, coins (heads or tails) or cards with 0 or 1 printed on them (to relate to the binary system).
2. What happens if two, or more, cards are flipped? (It is not always possible to know exactly which two cards were flipped, although it is possible to tell that something has been changed. You can usually narrow it down to one of two pairs of cards. With 4 flips it is possible that all the parity bits will be correct afterwards, and so the error could go undetected.)
3. Another interesting exercise is to consider the lower right-hand card. If you choose it to be the correct one for the column above, then will it be correct for the row to its left? (The answer is yes, always.)
4. In this card exercise we have used even parity—using an even number of coloured cards. Can we do it with odd parity? (This is possible, but the lower right-hand card only works out the same for its row and column if the numbers of rows and columns are both even or both odd. For example, a 5×9 layout will work fine, or a 4×6 , but a 3×4 layout won’t.)

A Real-Life Example for Experts!

This same checking technique is used with book codes. Published books have a ten-digit code usually found on the back cover. The tenth digit is a check digit, just like the parity bits in the exercise.

This means that if you order a book using its ISBN (International Standard Book Number), the publisher can check that you haven't made a mistake. They simply look at the checksum. That way you don't end up waiting for the wrong book!

Here's how to work out the checksum:

Multiply the first digit by ten, the second by nine, the third by eight, and so on, down to the ninth digit multiplied by two. Each of these values is then added together.

For example, the ISBN 0-13-911991-4 gives a value

$$\begin{aligned} & (0 \times 10) + (1 \times 9) + (3 \times 8) + (9 \times 7) + (1 \times 6) \\ & + (1 \times 5) + (9 \times 4) + (9 \times 3) + (1 \times 2) \\ & = 172 \end{aligned}$$

Then divide your answer by eleven. What is the remainder?

$$172 \div 11 = 15 \text{ remainder } 7$$

If the remainder is zero, then the checksum is zero, otherwise subtract the remainder from 11 to get the checksum.

$$11 - 7 = 4$$

Look back. Is this the last digit of the ISBN? Yes!

If the last digit of the ISBN wasn't a four, then we would know that a mistake had been made.

It is possible to come up with a checksum of the value of 10, which would require more than one digit. When this happens, the character X is used.

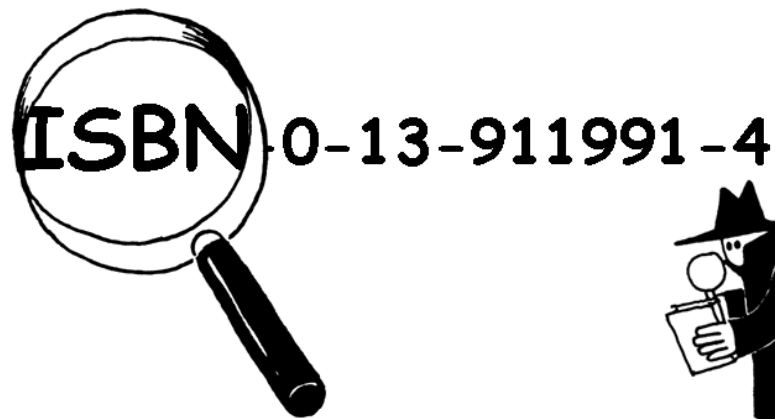


▲ A barcode (UPC) from a box of Weet-Bix™

Another example of the use of a check digit is the bar codes on grocery items. This uses a different formula. If a bar code is misread the final digit should be different from its calculated value. When this happens the scanner beeps and the checkout operator re-scans the code.

Check that book!

Detective Blockbuster
Book Tracking Service, Inc.



We find and check ISBN checksums for a small fee.

Join our agency—look in your classroom or library for real ISBN codes.

Are their checksums correct?

Sometimes errors are made.

Some of the common errors are:

- ✗ a digit has its value changed;
- ✗ two adjacent digits are swapped with each other;
- ✗ a digit is inserted in the number; and
- ✗ a digit is removed from the number

Can you find a book with the letter X for a checksum of 10? It shouldn't be too hard to find—one in every 11 should have it.

What sort of errors might occur that wouldn't be detected? Can you change a digit and still get the correct checksum? What if two digits are swapped (a common typing error)?

What's it all about?

Imagine you are depositing \$10 cash into your bank account. The teller types in the amount of the deposit, and it is sent to a central computer. But suppose some interference occurs on the line while the amount is being sent, and the code for \$10 is changed to \$1,000. No problem if you are the customer, but clearly a problem for the bank!

It is important to detect errors in transmitted data. So a receiving computer needs to check that the data coming to it has not been corrupted by some sort of electrical interference on the line. Sometimes the original data can be sent again when an error has been transmitted, but there are some situations when this is not feasible, for example if a disk or tape has been corrupted by exposure to magnetic or electrical radiation, by heat or by physical damage. If data is received from a deep space probe, it would be very tedious to wait for retransmission if an error had occurred! (It takes just over half an hour to get a radio signal from Jupiter when it is at its closest to Earth!)

We need to be able to recognize when the data has been corrupted (*error detection*) and to be able to reconstruct the original data (*error correction*).

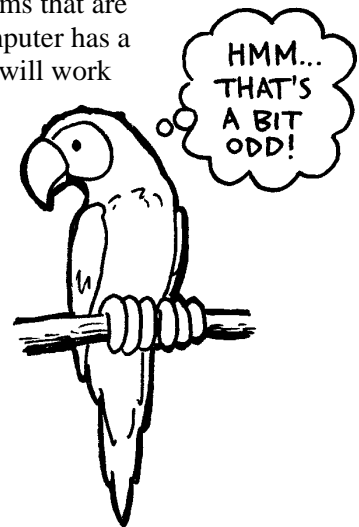
The same technique as was used in the “card flip” game is used on computers. By putting the bits into imaginary rows and columns, and adding parity bits to each row and column, we can not only detect if an error has occurred, but *where* it has occurred. The offending bit is changed back, and so we have performed error correction.

Of course computers often use more complex error control systems that are able to detect and correct multiple errors. The hard disk in a computer has a large amount of its space allocated to correcting errors so that it will work reliably even if parts of the disk fail. The systems used for this are closely related to the parity scheme.

And to finish, a joke that is better appreciated after doing this activity:

Q: What do you call this: “Pieces of nine, pieces of nine”?

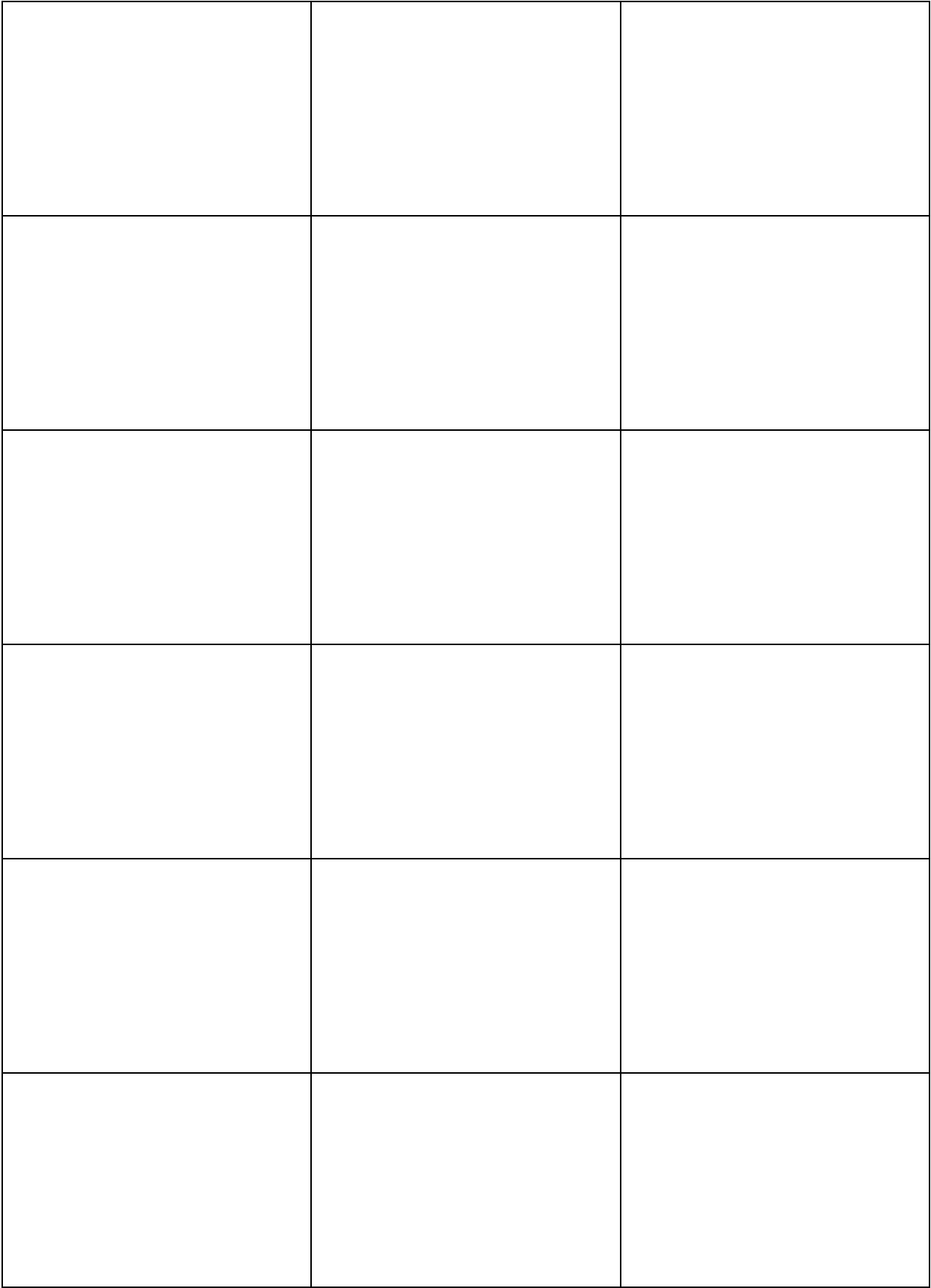
A: A parrotty error.



Solutions and hints

Errors that would not be detected are those where one digit increases and another decreases. Then the sum might still be the same.

You will need to cut out and color one side



You will need to cut out and color one side

