

Rethinking Circle Time
Reverse Sequencing:
Robot Mouse (Coded ver.)



<p>Lesson Summary</p>	<p>In this lesson, students listen to a story of a mouse called Anatole and discuss the events in the story, preparing them for a coding activity. Then, they work on forward and reverse sequencing using a robot mouse game to move the mouse robot through a course. Students get the mouse to the cheese on a previously determined map requiring they go into and out one tunnel off to the side before they can successfully get the cheese.</p>
<p>Grade Level</p>	<p>K-2</p>
<p>Subjects Addressed</p>	<p>Computational Thinking: <i>Algorithms & Procedures:</i> Forwarding and reverse sequence. <i>Debugging:</i> Finding and fixing errors in their code (the sequence of arrows).</p> <p>Literacy: <i>Vocabulary and comprehension:</i> Developing an understanding of the reading by discussing the story with classmates and the teacher. Build up new words to their vocabulary through the story.</p>
<p>Standards</p>	<ul style="list-style-type: none"> ● CCSS-ELA: <ul style="list-style-type: none"> ○ Literacy.SL - 1.1, 1.2, 1.3, 1.4 ○ Literacy.RL - 1.3, 1.7, 1.9 ● CSTA: 1A-DA-06, 1A-AP-09, 1A-AP-10, 1A-AP-11, 1A-AP-12, 1A-AP-14
<p>Learning Objectives</p>	<p>Students will be able to:</p> <ul style="list-style-type: none"> ● Computational Thinking: <ul style="list-style-type: none"> ○ <i>Algorithms & Procedures:</i> Create a sequence of steps using coding cards to solve a given problem ○ <i>Data Representation:</i> Represent their sequence through coding cards ○ <i>Debugging:</i> Revise their coding identifying and fixing mistakes ● Literacy: <ul style="list-style-type: none"> ○ <i>Reading Comprehension:</i> Connect ideas in the story applying and extending these ideas to the coding problem. Students will answer questions about the guided reading and make predictions about the story. ○ <i>Vocabulary:</i> Understand and acquire new words to their vocabulary.
<p>Teacher Background and Content Information</p>	<p>Vocabulary and comprehension: As part of this lesson, you will read aloud a story that will help students get familiar with the context of the activity. The objective is to introduce and contextualize the activity that will come next, as well as engage students to arouse their interest in the mouse activity. The vocabulary and comprehension part comes during and after the reading when you ask students questions about the story and explain the words that you think are unfamiliar to them or they ask the meaning.</p>

Sequencing: Sequencing is a computational thinking concept as part of the idea of algorithms. Algorithms are step-by-step, ordered procedures to accomplish a task. Students must learn to create directions so a machine can follow them and produce the intended result. This activity is meant to explore the idea of sequencing and the students' ideas of reversing directions as a computational sequencing strategy.

Note that reversing the original sequence in the robot mouse game is not simply a one-to-one reversal. There is higher-order logic involved. In the first part of the game, the robot mouse aims to get the cheese, and the mouse returns through the same path in the second part. When reversing the order sequence of the coding cards to return the mouse to the original start point, students may not realize they have to change the arrow cards when they do so. For example, the down arrow instead of the up arrow, and left instead of right; otherwise, the mouse will end up on the opposite side, leading in the wrong direction. They might also recode the entire thing when they realize that simply reversing their plan does not yield the desired results. This is one of the fun parts of this activity - watching the students think through this logic.

Debugging: When students code the directions that will take the mouse to the cheese, it might not work as expected because of mistakes they might have made when planning the directions. The process of identifying and fixing errors in the code is known as debugging. They will need to engage in debugging all the time throughout the activity by revisiting their plan and making changes. Students learn to erase the entire code instead of looking for the specific piece in the code that is wrong. Invite students to identify the error instead of erasing the entire code. The teacher may facilitate and promote this practice, particularly when you notice students are stuck.

The activity: In this lesson, we will test the students' ability to understand that the directions cannot simply be reversed; they need to use logic to flip certain aspects of it. To reverse the code, not only does the entire plan need to be flipped, but the direction of the arrows needs to be flipped as well (i.e., left becomes right, up becomes down vice versa). We recommend that you do this activity yourself before to familiarize yourself and help you understand the expectations.

While administering this activity, it is important to keep an eye out for students' understanding of forwarding and reverse sequences:

- Note whether or not students connect the instructions/plan to the execution (ex: following their directions when they use or act out the mouse);
- Note whether or not students connect the forward and reverse activities (ex: starting over completely when planning out the reverse activity or starting with their previous plan developed in the forward activity and flipping it to give the reverse directions);
- Note if students go beyond simply flipping their plan from the forward activity (ex: using the inverse of each arrow direction within the plan after flipping it).

Differentiate/ Inclusion

The teacher can decrease or increase the activity's difficulty level depending on how students respond. If you realize the activity became too easy and boring for the students, you can add a second tunnel to the course to make it more challenging. You can also adapt the activity for lower grades, removing the tunnels, for example.

Materials

A robot mouse game set with a game-board, 1 tunnel, 1 mouse, 1 cheese, and coding cards

Overall Description

Launch/ Engage

1. **Introduce the book** *Anatole* by Eve Titus. Say: *This story is about a mouse named Anatole who used to go to the city and take cheese away from people to feed his beloved family. Let's listen to this story.*
2. **Read the story aloud.** As you read, pause to ask and answer their questions to ensure students follow the reading and for clarification. It will help to keep them engaged.
3. **Discussion.** After reading, discuss the story with the students, asking them questions about it and clarifying words they seem not to understand. For example, ask what other words people use to say to mention a mouse. Explore these words and their meaning with them—for instance, mice, rats, hamsters. You can ask students if they have ever seen a mouse and explore their physical features, what they eat and where they usually live. These are just some ideas, but feel free to raise other topics that can be discussed related to the story as you judge pertinent.

Explore

1. **Introduce the activity** by noticing if they connect this game to the story 'Anatole.' Help them to make this connection if they don't.
Say: *We just read the story of a mouse called Anatole who needed to feed his beloved family. Now, we will play a game with the robot mouse game you see in front of you. You will help Anatole - the mouse device - and your goal is to make a plan that helps Anatole find the cheese to bring to his family.*
Ask: *Do you have a pet who never follows your directions? What do you do if they don't do what you want them to do?*
2. **Introduce the rules of the game (Part I).** After listening to students' answers and engaging in a short discussion, say:
In this game, you will help Anatole to go to the city to get cheese and bring it to his family. You will help him by giving Anatole the correct directions to find the cheese and walk the same path back to his family, and he will only do what you ask him to do. Anatole is a nice mouse, and he will only follow your directions. If you give him the wrong direction, he will end up lost! But don't worry, you can always revise and fix your directions.
Explain: *Anatole has to use a tunnel before you can get to the cheese. Once the mouse uses a tunnel, you can continue on to find the cheese*
 - Ask for student confirmation and answer questions
 - Ask: *Do you have any questions about the rules?*
 - Answer student questions about the activity.
3. **Introduce the robot mouse game.** Gather students in a circle to look at the robot mouse game as a group. Demonstrate the mouse device's functions being intentional in showing students how you push direction buttons on the mouse to control the mouse movements. Ask volunteers to go to the middle of the circle and try the mouse device and its functions. Ensure to use appropriate language to refer to the functions of the mouse. For example, the up arrow button would be a forward button, the down arrow is backward, etc. Say: *Here is our mouse, Anatole. He will only*

go where you direct him to go. So if you want him to take two steps forward, what are the button(s) you will need to press?

Then ask them to press the buttons and see what happens. They will eventually make mistakes. It is important to reinforce that mistakes happen and that it is okay if they end up making a mistake. Say: *Do not worry if you make a mistake and Anatole ends up going to a path you did not intend to take. Everyone will make mistakes here and there during this activity, and it is okay! There will be moments when we must identify the errors and redo the directions. Every time we do that, we will be debugging. Every time you are stuck and unsure what to do, you will need to debug your arrows - code.*

Ask students what questions they have before moving on to the activity. Ensure to clarify their questions since it should be clear to them how the mouse works before starting to play.

Summarize/ Explain

1. **Wrap up.** Say: *Today, we read the story of a mouse called Anatole and his family. Every evening he used to bicycle with his friend, Gaston toward Paris to find food for their families. One night, while looking for leftovers in someone's kitchen, Anatole heard people talking about how terrible mice are! They sneak into the kitchen and take what is there, they said.*

Ask: *Do you remember how Anatole felt when listening to these words? Who can tell us the solution Anatole found to make up for this?*

Listen to the children's answers and remind them how they helped Anatole to take cheese to his family. Ask: *Does anyone remember what we did to help him to get cheese for his beloved family? What happened when you tried to bring Anatole back through the same path? Did you have to make changes in the sequence of the arrows? Why?* The teacher can walk students through the activity and go back to the piece where the teacher explains the trick about the reverse part.

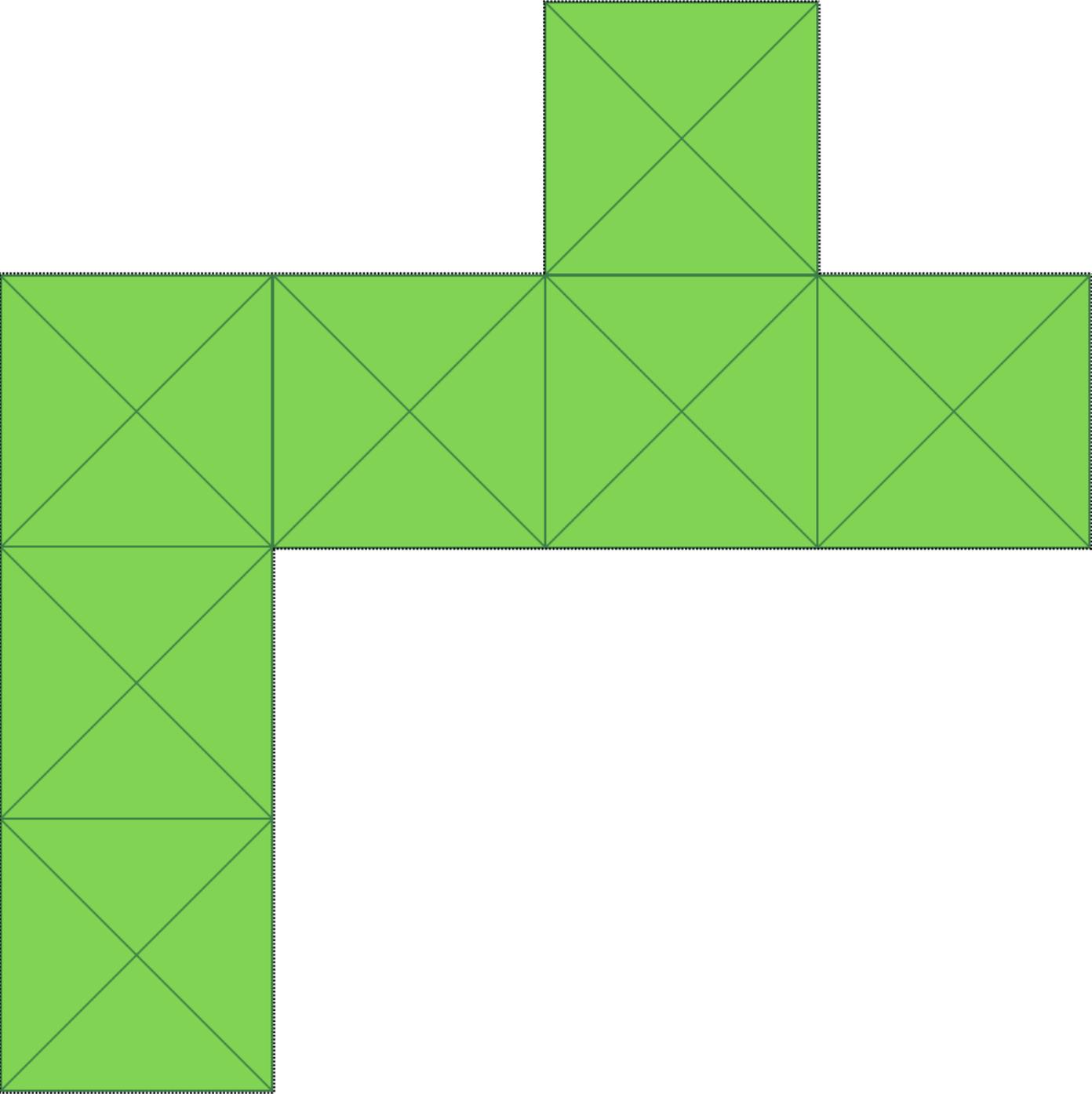
Apply/ Extend

You can also ask students to work in pairs: student A works on the plan portion, and then student B follows student A plan. **Another idea** is having students create a sequence that the teacher will follow. **A different activity would be** using the story timeline of events: You can prepare picture cards of the story and ask them to put it in order and retell the story to their colleagues based on their picture cards. **Another suggestion** is to ask them to tell what they usually do when they wake up before arriving at school:

Ask: *Do you have a plan before arriving at School? What do you usually do before getting there? What if you change the order of these events? - i.e., instead of waking up and eating, you first brush your teeth and eat after that? Or what if you take the school bus before getting ready for school? What would happen? What would be the logical order in this situation? Why?*

Teacher Notes

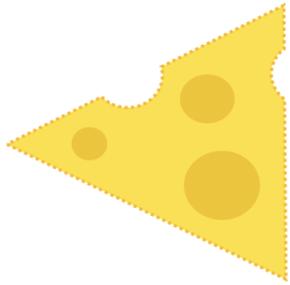
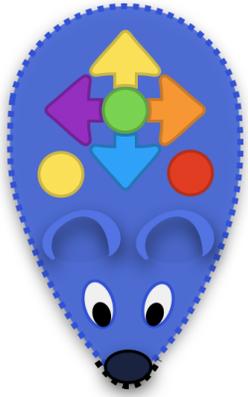
The board-game map



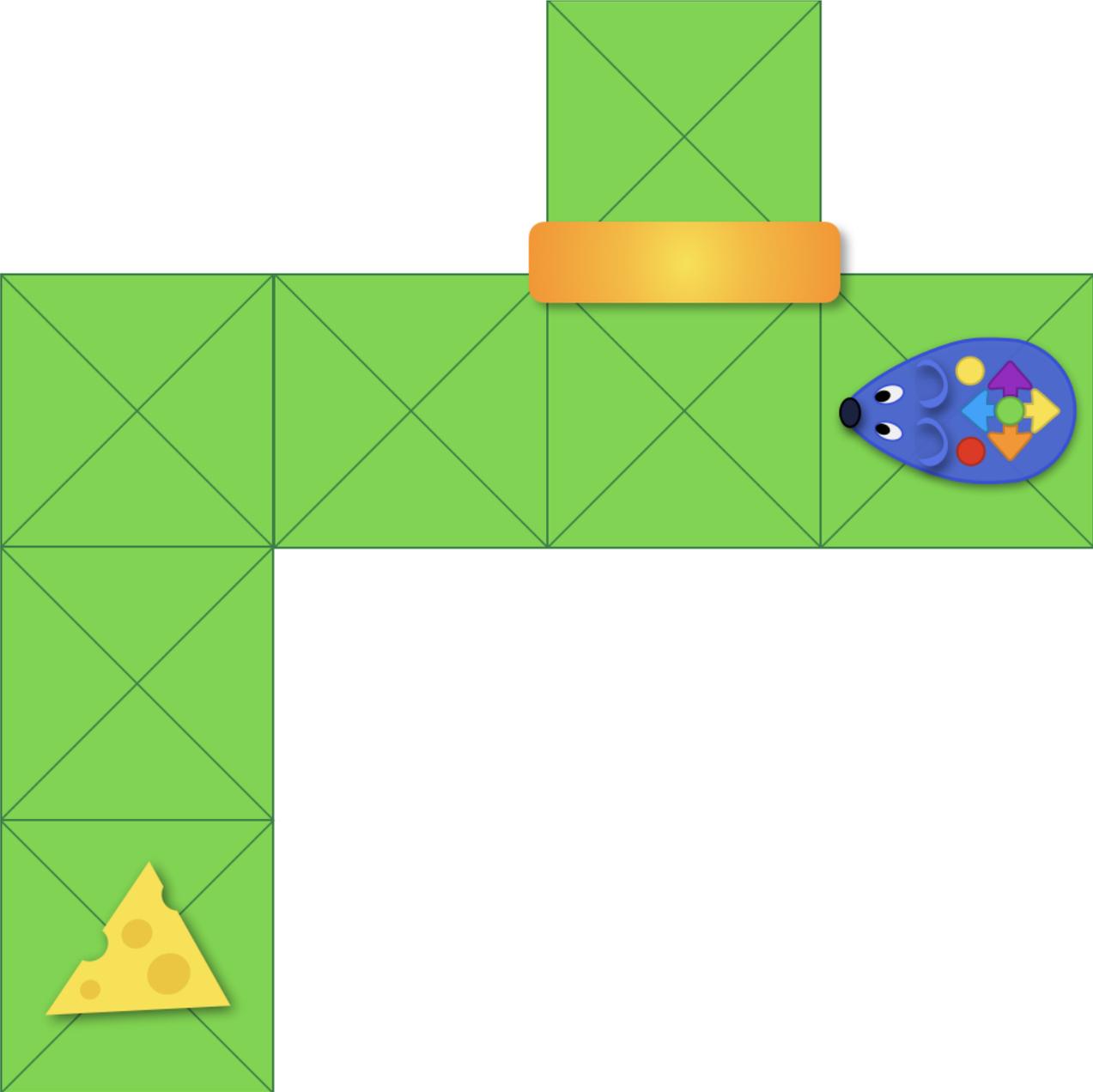
The Tunnel



The mouse and the cheese



The game



Rethinking Circle Time
Reverse Sequencing:
Robot Mouse (Unplugged ver.)



<p>Lesson Summary</p>	<p>In this lesson, students work on forward and reverse sequencing using a board-game set up to move the mouse piece through a version of the map used in the coded version (Lesson Plan 3-A). Students get the mouse to the cheese on a previously determined map requiring they go into and out at least one tunnel off to the side before they can successfully get the cheese. The teacher will read a book before the coding activity, giving students context to introduce the board game.</p>
<p>Grade Level</p>	<p>K-2</p>
<p>Subjects Addressed</p>	<p>Computational Thinking: <i>Algorithms & Procedures:</i> Forwarding and reverse sequence. <i>Debugging:</i> Finding and fixing errors in their code (the sequence of arrows).</p> <p>Literacy: <i>Vocabulary and comprehension:</i> Developing an understanding of the reading by discussing the story with classmates and the teacher. Build up new words to their vocabulary through the story.</p>
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Note that reversing the original sequence in the robot mouse game is not simply a one-to-one reversal. There is higher-order logic involved. In the first part of the game, the robot mouse aims to get the cheese, and the mouse returns through the same path in the second part. When reversing the order sequence of the coding cards to return the mouse to the original start point, students may not realize they have to change the arrow cards when they do so. For example, the down arrow instead of the up arrow, and left instead of right; otherwise, the mouse will end up on the opposite side, leading in the wrong direction. They might also recode the entire thing when they realize that simply reversing their plan does not yield the desired results. This is one of the fun parts of this activity - watching the students think through this logic.

Debugging: When students code the directions that will take the mouse to the cheese, it might not work as expected because of mistakes they might have made when planning the directions. The process of identifying and fixing errors in the code is known as debugging. They will need to engage in debugging all the time throughout the activity by revisiting their plan and making changes. Students learn to erase the entire code instead of looking for the specific piece in the code that is wrong. Invite students to identify the error instead of erasing the entire code. The teacher may facilitate and promote this practice, particularly when you notice students are stuck.

The activity: In this lesson, we will test the students' ability to understand that the directions cannot simply be reversed; they need to use logic to flip certain aspects of it. To reverse the code, not only does the entire plan need to be flipped, but the direction of the arrows needs to be flipped as well (i.e., left becomes right, up becomes down vice versa). We recommend that you do this activity yourself before to familiarize yourself and help you understand the expectations.

While administering this activity, it is important to keep an eye out for students' understanding of forwarding and reverse sequences:

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Differentiate/ Inclusion

The teacher can decrease or increase the activity's difficulty level depending on how students respond. If you realize the activity became too easy and boring for the students, you can add a second tunnel to the map to make it more challenging. You can also adapt the activity for lower grades, removing the tunnels, for example.

Materials

- A game-board, 1 tunnel, 1 mouse, 1 cheese, and coding cards. Tape and velcro if needed.
- Print the game-board (page X) and cut it out along the dotted line
 - Print and cut out 1 tunnel, 1 mouse, 1 cheese, and coding cards (page X) on the dotted lines
 - Assemble the tunnel by folding along the solid lines to create flaps
 - Set up the game as shown in the game board image (page X)
 - Tape the tunnel flaps to the board to create the arch-like shape for the students to guide the mouse through
 - Alternatively slits can be cut in the game board so the flaps can be fed through the board and taped to the bottom instead of being visible sitting on top
 - Additionally velcro can be used with one side on the cheese piece and one side on the mouse piece so when the students do the reverse task they can carry the cheese back to where they started.
 - Distribute the coding cards among the students.

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1. **Introduce the book** *Anatole* by Eve Titus. Say: *This story is about a mouse named Anatole who used to go to the city and take cheese away from people to feed his beloved family. Let's listen to this story.*
2. **Read the story aloud.** As you read, pause to ask and answer their questions to ensure students follow the reading and for clarification. It will help to keep them engaged.
3. **Discussion.** After reading, discuss the story with the students, asking them questions about it and clarifying words they seem not to understand. For example, ask what other words people use to say to mention a mouse. Explore these words and their meaning with them—for instance, mice, rats, hamsters, mouse. You can ask students if they have ever seen a mouse and explore their physical features and what they eat and usually live. These are just some ideas, but feel free to raise other topics that can be discussed related to the story as you judge pertinent.

Explore

1. **Introduce the activity** by noticing if they connect this game to the story 'Anatole.' Help them to make this connection if they don't.
Say: *We just read the story of a mouse called Anatole who needed to feed his beloved family. Now, we will play a game with the pieces you see in front of you. You will help Anatole - the mouse piece - and your goal is to come up with a plan that helps Anatole find the cheese to bring to his family.*
Ask: *Do you have a pet who never follows your directions? What do you do if they don't do what you want them to do?*
2. **Introducing the game (Part I)** After listening to students' answers and engaging in a short discussion, say:
In this game, you will help Anatole to go to the city to get cheese and bring it to his family. You will help him by giving Anatole the correct directions to find the cheese

and walk the same path back to his family, and he will only do what you ask him to do. Anatole is a nice mouse, and he will only follow your directions. If you give him the wrong direction, he will end up lost! But don't worry, you can always revise and fix your directions.

Explain: Anatole has to use a tunnel before you can get to the cheese. Once the mouse uses a tunnel, you can continue on to find the cheese

- Ask for student confirmation and answer questions
 - Ask: *Do you have any questions about the rules?*
 - Answer student questions about the activity.
- 3. **Planning.** Say: *Now that you have heard the rules and know your job, it's time to plan out the directions you will use to help Anatole find the cheese.*
 - Give the student coding cards and help them plan out (off to the side) how they want to use the tunnel(s) to get to the cheese;
 - Take pictures of student codes for documentation before they try out their code each time;
Say: *You can use these cards to plan out how you are going to get to the cheese and don't forget to include the tunnel(s) in your plan!*
 - Observe the planning process noting whether they use the left and right arrows to turn or use them as a combined turn and move forward card. They can plan out whatever makes sense to them as they will be the ones deciphering and executing their plan.
 - Once they are done planning ask: *Okay do you have any questions before you start?* Answer student questions about the rules of the activity, ensuring students understand they need to use a tunnel before getting to the cheese.
- 4. **Trying.** Place the mouse in the starting spot facing the direction shown on the gameboard map:
 - Make sure students have their plan accessible to reference as directions.
Say: *Now it's time to use the plan you just finished to find the cheese. Make sure you are following every step of the directions you created!*
 - Observe the student process of interpreting and carrying out their plan, noting how they use the turning arrows specifically and any direction words they use to describe using the tunnel.
- 5. **Asking questions based on students' actions.**
 - If students followed their plan, but the mouse did not use the tunnel:
 - a. Encourage students to use the tunnel and observe how they debug their code to account for the tunnel
 - b. Say: *You have a good plan to get the mouse to the cheese. There is a part of the instructions you forgot, though.*
 - c. Ask: *Do you remember the rules I gave you at the beginning?*
 - d. Say: *You must make sure the mouse uses the tunnel before it can continue to find the cheese. Look at your plan to make sure your directions include the tunnel. Let's try it again!*

Help students incorporate the tunnel into their directions as this needs to be a part of their plan to understand their knowledge of the computational thinking components we are interested in for the reverse portion of the activity.

- If students followed their plan but did not get the mouse to the cheese:
 - a. Ask: *What ended up happening when you followed your plan? Why didn't you get to the cheese? How can you fix the mistakes in your plan so you can use it to help the mouse find the cheese?*
 - b. Help students debug so they can use the tunnel and make it to the cheese when they use their plan, even if they interpret it differently than we would.
 - c. Ask: *Okay, are you ready to try following your directions again?* Depending on how students approach the debugging process, they can start from their current spot or start back at the beginning.
- If students did not follow their plan but completed the task:
 - a. Ask: *How did you end up using the tunnel and finding the cheese? Did the mouse follow the directions you gave in your plan?*
 - b. Students may be satisfied with the plan they came up with but try to encourage students to compare the path they took to revise their directions. The goal is to end up with a plan at the end of part 1 that works to accomplish the task, so students have a starting point to work off of for part 2 when they reverse. Say: *Okay, you were able to use the tunnel and help Anatole find the cheese but let's try to change a few parts of the plan so it matches the path you took!*

No matter what steps students take, try to get to a point where how they interpret their plan gets them to use the tunnel and find the cheese. This will help set up the computational thinking aspects we focus on in part 2.

- If the students successfully help the mouse use the tunnel and get to the cheese using their plan, they can move on to the reverse activity. But, before ensure that you:
 - a. Take a picture of student codes for documentation
 - b. Say *Congratulations! You created a helpful plan and followed the directions to get Anatole to the cheese! Now it's important that you remember your position in the game because the next part will be trying to get back to where you started.*
 - If you have velcro available, you can adhere the cheese to the mouse so the mouse can carry it back to its starting place
 - Alternatively, you can place the cheese over the mouse piece and pretend that the mouse is carrying the cheese in his back.

6. Introducing Part 2: Reverse

- Make sure students have their previously developed directions in front of them from the forward activity to work off of during the reverse activity.
- Take pictures of student codes for documentation before they try out their code each time.
- Say: *Now that you used the tunnel to help Anatole find the cheese, it's time to figure out how to get back to the starting point. Think about how you can change your plan*

so you can follow your directions to get back to where you started, and don't forget about having to use the tunnel again! Do you have any questions before we start?

7. **Planning.** Answer student questions about the task, then direct students to adjust their plan with coding cards before they start moving to the mouse.
 - Say: *Before trying to find your way back to the beginning, look at your plan and figure out how to reverse it, so our friend Anatole ends up where he started. Like before, you must use the tunnel before returning to your starting place! Once you develop your new plan, you can follow those directions to help Anatole use the tunnel and get back to its starting place.*
 - Observe the planning process and note any direction words students use as well as whether the students flip the entire plan or code the whole thing again. **As the students should all start from a valid path as they interpret it, this piece is important for understanding how they reverse their plan. Without the literacy component from Joey and Jet, this activity can show what the students know about the reverse sequencing aspect of computational thinking. Note how they use the arrows corresponding to turns, as the plan cannot simply be flipped, especially with the tunnel portion of the map.**
8. **Try.** When students are done revising their plan, direct them to follow their directions to get back to the beginning.
 - If the pieces have velcro attached, the students can adhere the cheese to the mouse to carry it back to the beginning. If not, they can place the cheese over the mouse piece pretending the mouse is carrying it.
 - Say: *Now it's time to follow your directions to help the mouse use the tunnel and end up back at the starting place!*
 - Observe the student process of following their plan, including the direction words they use. Between their plan and the execution, students may reverse the coding card order sequence but not realize they have to change the arrows when they do so (like down instead of up and left instead of right). Alternatively, they could recode the entire thing when they realize simply reversing their plan does not give them the desired results. **This piece is the key to understanding what the students know about the computational thinking competency in this activity. After the correct path has been established with the cards and code, there are correct ways to reverse it, and this piece tests the students' ability to do so.** Note where students tend to get stuck as well as points of understanding.
9. **Debugging.** Ask the following questions based on student actions:
 - If students don't use the tunnel, try to flip the entire forward plan front to back without changing anything else, or just don't accomplish the task in general:
 - Say: *When you followed your plan it didn't get the mouse back to the beginning.*
 - Ask: *How can you adjust your plan so you have the right directions for the mouse to ensure it uses the tunnel and gets back to where it started?*

- Observe the debugging process noting if the students discuss the problems that occur when simply flipping the plan front to back without also flipping the arrows
 - Say: *Okay, now that you have adjusted your plan, let's try to follow your directions again and see if that gets the mouse first to the tunnel then back to the starting place*
- If students accomplish the task using a completely new plan try to find out how students interpreted the task
 - Students may have separated the reverse task from the forward one not realizing that the sequence they were starting with could have been used to work from.
 - This is similar to students who don't use their plan as directions to get back to the beginning. This demonstrates aspects of sequences they may not connect.
 - Say: *You did a great job using the tunnel and getting Anatole back to his starting place! Is there anything you noticed about the paths you took to get to the cheese and then return to the starting place? Are there similarities or differences between your plans?*
 - Note any connections they make between the two tasks.
- Take a picture of student codes for documentation.
- Once students get back to the start and talk through their process, say: *You did a great job helping Anatole get the cheese and take it to his family using the tunnel! His family must be happy now. Anatole and his family, thank you for your help today!*

**Summarize/
Explain**

1. **Wrap up.** Say: *Today, we read the story of a mouse called Anatole and his family. Every evening he used to bicycle with his friend, Gaston toward Paris to find food for their families. One night, while looking for leftovers in someone's kitchen, Anatole heard people talking about how terrible mice are! They sneak into the kitchen and take what is there, they said.*
 Ask: *Do you remember how Anatole felt when listening to these words? Who can tell us the solution Anatole found to make up for this?*
 Listen to the children's answers and remind them how they helped Anatole to take cheese to his family. Ask: *Does anyone remember what we did to help him to get cheese for his beloved family? What happened when you tried to bring Anatole back through the same path? Did you have to make changes in the sequence of the arrows? Why?*
 The teacher can walk students through the activity and go back to the piece where the teacher explains the trick about the reverse part.

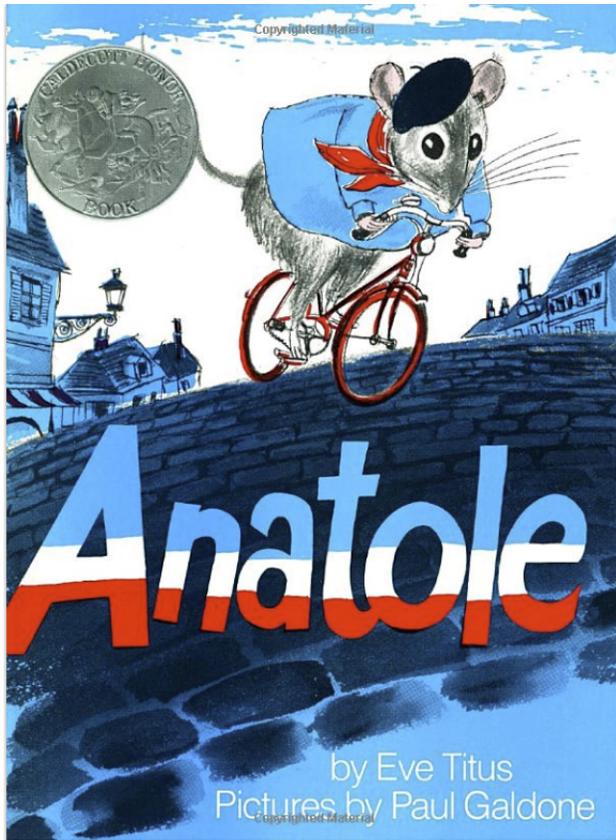
**Apply/
Extend**

You can also ask students to work in pairs when student A works on the plan portion, and then student B follows student A plan. **Another idea** is having students create the sequence when the teacher follows the sequence. **A different activity would be** using the sequence in the story where children need to order the sequence of the events. You can prepare picture cards of the story and ask them to put it in order and retell the story to their colleagues based on their picture cards. **Another suggestion** is to ask them to tell what they usually do when they wake up before arriving at school:

Ask: *Do you have a plan before arriving at School? What do you usually do before getting there? What if you change the order of these events? - i.e., instead of waking up and eating, you first brush your teeth and eat after that? Or what if you take the school bus before getting ready for school? What would happen? What would be the logical order in this situation? Why?*

Teacher Notes

The book:

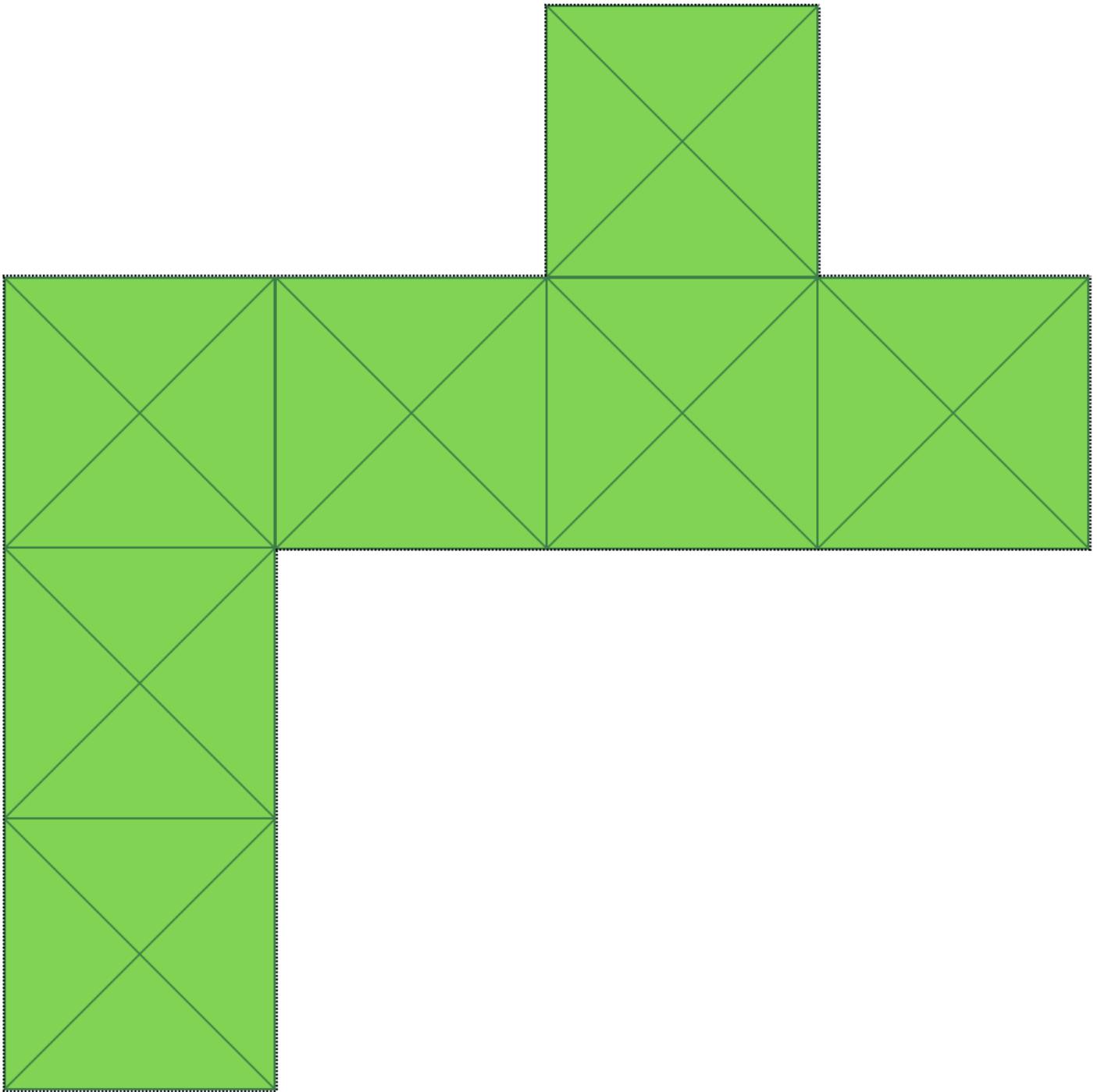


Every evening as the sky darkened
the husbands and fathers bicycled along the boulevard toward Paris
to find food for their families.

Once arrived, they entered people's houses
through secret passageways, known only to themselves.
Anatole's partner was usually Gaston.

Printout materials

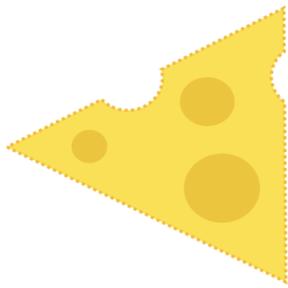
The board-game map



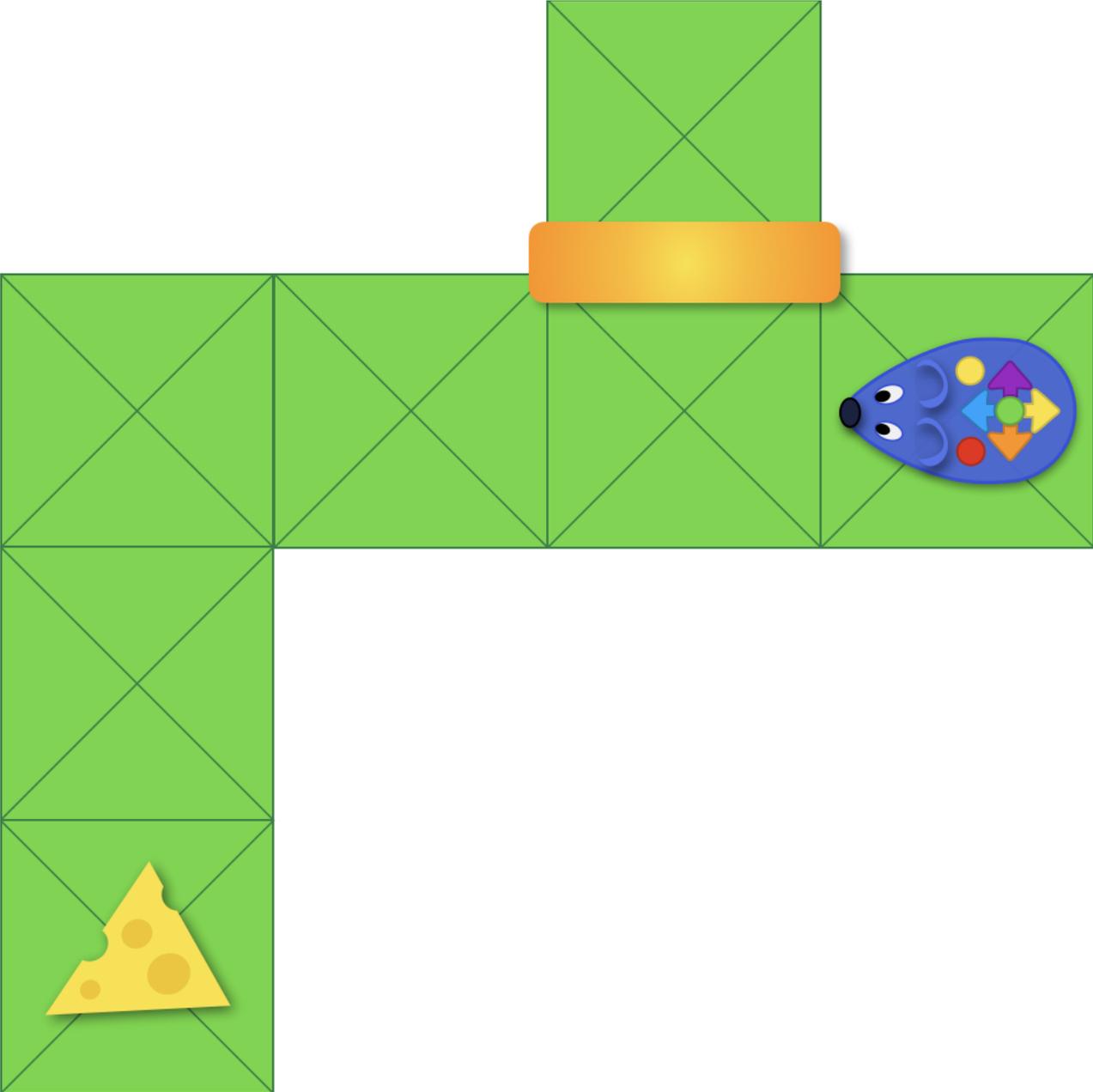
The Tunnel



The mouse and the cheese



The game



Rethinking Circle Time
Reverse Sequencing:
Robot Mouse (Embodied ver.)



<p>Lesson Summary</p>	<p>In this lesson, students work on forward and reverse sequencing enacting themselves as the mouse walking over the green blocks, tunnel, and cheese mapped out on the floor to represent the map used in the coded version (Lesson Plan 3-A). Students act as the mouse to get to the cheese following a previously determined map (unplugged version). The map requires them to go into and out at least one tunnel off to the side before they can successfully get the cheese. The teacher will read a book before the coding activity, engaging students in the context of the coding game.</p>
<p>Grade Level</p>	<p>K-2</p>
<p>Subjects Addressed</p>	<p>Computational Thinking: Algorithms & Procedures: Forwarding and reverse sequence. Debugging: Finding and fixing errors in their code (the sequence of card arrows).</p> <p>Literacy: Vocabulary and comprehension: Developing an understanding of the reading by discussing the story with classmates and the teacher. Build up new words to their vocabulary through the story.</p>
<p>Standards</p>	<ul style="list-style-type: none"> ● CCSS-ELA: <ul style="list-style-type: none"> ○ SL 1.1.B; 1.1.C; SL 1.2, 1.4 ○ RL K.2, K.3, K.7; ○ L.K.1.E; SL.K.6 ○ RL.1.2, 1.7; L.1.1.I; SL.1.1 ○ RL 2.5, 2.7; ● CSTA: 1A-DA-06, 1A-AP-09, 1A-AP-10, 1A-AP-11, 1A-AP-12, 1A-AP-14
<p>Learning Objectives</p>	<p>Students will be able to:</p> <ul style="list-style-type: none"> ● Computational thinking: <ul style="list-style-type: none"> ○ <i>Algorithms & Procedures:</i> Create a sequence of steps using coding cards (arrows) to solve a given problem ○ <i>Data Representation:</i> Represent their sequence through coding cards ○ <i>Debugging:</i> Revise their coding identifying and fixing mistakes ● Literacy: <ul style="list-style-type: none"> ○ <i>Reading comprehension:</i> Connect ideas in the story applying and extending these ideas to the coding problem. Students will answer questions about the guided reading and make predictions about the story. ○ <i>Vocabulary:</i> Understand and acquire new words to their vocabulary.
<p>Teacher Background and Content</p>	<p>Vocabulary and comprehension: As part of this lesson, you will read aloud a story that will help students get familiar with the context of the activity. The objective is to introduce and contextualize the activity that will come next, as well as engage students to arouse their</p>

Information

interest in the mouse activity. The vocabulary and comprehension part comes during and after the reading when you ask students questions about the story and explain the words that you think are unfamiliar to them or they ask the meaning.

Sequencing: Sequencing is a computational thinking concept as part of the idea of algorithms. Algorithms are step-by-step, ordered procedures to accomplish a task. Students must learn to create directions so a machine can follow them and produce the intended result. This activity is meant to explore the idea of sequencing and the students' ideas of reversing directions as a computational sequencing strategy.

Note that reversing the original sequence in the robot mouse embodied game is not simply a one-to-one reversal. There is higher-order logic involved. In the first part of the game, students act as a mouse following a sequence of steps aiming to get the cheese, then they return through the same path in the second part of the activity. When reversing the order sequence of the coding cards to return to the original start point, students may not realize they have to change the arrow cards in their original plan. For example, the down arrow instead of the up arrow, and left instead of right; otherwise, they will end up on the opposite side, leading in the wrong direction. They might also recode the entire thing when they realize that simply reversing their plan does not yield the desired results. This is one of the fun parts of this activity - watching the students think through this logic.

Debugging: When students code the directions that will take them to the cheese, it might not work as expected because of mistakes they might have made when planning the directions. The process of identifying and fixing errors in the code is known as debugging. They will need to engage in debugging all the time throughout the activity by revisiting their plan and making changes. Students learn to erase the entire code instead of looking for the specific piece in the code that is wrong. Invite students to identify the error instead of erasing the entire code, although it is okay if they do so. The teacher may facilitate and promote this practice, particularly when you notice students are stuck.

The activity: In this lesson, we will test the student's ability to understand that the directions cannot simply be reversed; they need to use logic to flip certain aspects of it. To reverse the code, not only does the entire plan need to be flipped, but the direction of the arrows needs to be flipped as well (i.e., left becomes right, up becomes down vice versa). We recommend that you do this activity yourself before to familiarize yourself and help you understand the expectations.

While administering this activity, it is important to keep an eye out for students' understanding of forwarding and reverse sequences:

- Note whether or not students connect the instructions/plan to the execution (ex: following their directions when they act out the mouse);
- Note whether or not students connect the forward and reverse activities (ex: starting over completely when planning out the reverse activity or starting with their previous plan developed in the forward activity and flipping it to give the reverse directions);
- Note if students go beyond simply flipping their plan from the forward activity (ex: using the inverse of each arrow direction within the plan after flipping it).

Differentiate/ Inclusion

The teacher can decrease or increase the activity's difficulty level depending on how students respond. If you realize the activity became too easy and boring for the students,

you can add a second tunnel to the map or/and modify the map to make it more challenging. Ensure the physical map - the green blocks on the floor with the tunnel(s) - reflect these modifications. You can also adapt the activity for lower grades, removing the tunnels, for example.

Materials

7 green blocks, 1 tunnel, 1 mouse placard or mouse ears, 1 cheese slice, and coding cards. Velcro as an option to attach the cheese to their placard.

- Print and cut out 1 student mouse placard (attached to the end of this lesson) then tie yarn to two corners of the mouse card for a student to wear
 - Alternatively students can wear the mouse ears secured to a headband using the mouse ears (attached to the end of this lesson) **however, because these will go in their hair each student will need their own headband**
 - Just print and cut out the mouse ears then fold and tape the tabs under a headband
 - If you are unable to get plastic headbands for each student the ears can be taped to a strip of paper and stapled into the shape of a ring for the students to wear around their heads
- Print and cut out 7 green blocks (attached to the end of this lesson)
- Print and cut out 1 cheese slice (attached to the end of this lesson)
- Create 1 tunnel
 - Possibly set up two desks to represent the base of the tunnel on either side of a green block space and connect the top of the desks with cardboard, paper, or fabric (preferably orange to represent the tunnels in the robot mouse game)
 - Two other students could stand facing each other on either side of a green block space with their hands touching to represent a tunnel
- Set up the green blocks, cheese, and tunnels to represent the map image (attached to the end of this lesson)

Overall Description

Launch/ Engage

1. **Introduce the book** *Anatole* by Eve Titus. Say: *This story is about a mouse named Anatole who used to go to the city and take cheese away from people to feed his beloved family. Let's listen to this story.*
2. **Read the story aloud.** As you read, pause to ask and answer their questions to ensure students follow the reading and for clarification. It will help to keep them engaged.
3. **Discussion.** After reading, discuss the story with the students, asking them questions about it and clarifying words they seem not to understand. For example, ask what other words people use to say to mention a mouse. Explore these words and their meaning with them—for instance, mice, rats, hamsters, mouse. You can ask students if they have ever seen a mouse and explore their physical features and

what they eat and usually live. These are just some ideas, but feel free to raise other topics that can be discussed related to the story as you judge pertinent.

1. **Introduce the activity:**

- Notice if they connect this game to the story 'Anatole.' Help them to make this connection if they don't.

Say: We just read the story of a mouse called Anatole who needed to feed his beloved family. Now, we will play a game with the pieces you see in front of you. You will be Anatole, and your goal is to come up with a plan to get the cheese to bring to your family.

Ask: Do you have a pet who never follows your directions? What do you do if they don't do what you want them to do?

- Notice if they connect this game to any previous exposure to the robot mouse if it is the case.

Ask: Do you remember any similar activities we have done before?

Ask follow-up questions based on their answers. For example, if they have difficulty connecting this activity with the previous one using the robot mouse, you could ask: *Do you remember we used it before? What did we do back then?*

2. **Introducing the game (Part I)** After listening to students' answers and engaging in a short discussion, say:

In this game, you will be Anatole going to the city to get cheese and bring it to your family. You will need to think about the correct directions to find the cheese and walk the same path back to your house, and you will follow the exact directions you created. If you give the wrong direction, you will end up lost! But don't worry, you can always revise and fix your movements. But, you only can fix your directions using the arrow cards. You cannot fix it by simply changing your path while walking the green blocks.

Explain: You, as Anatole, have to use a tunnel before you can get to the cheese. Once you use a tunnel, you can continue to find the cheese.

- Show the printed version of the map (available in the 'printed material' section of this lesson) as you explain the activity.

Ask for students' confirmation and answer questions:

- Ask: *Do you have any questions about the rules?*
- Answer student questions about the activity.

3. **Planning.** *Say: Now that you have heard the rules and know your job, it's time to plan the directions you will use to find the cheese.*

- Give the student coding cards and help them plan out (off to the side) how they want to use the tunnel(s) to get to the cheese;
- Take pictures of student codes for documentation before they try out their code each time;

Say: You can use these cards to plan out how you are going to get to the cheese and don't forget to include the tunnel(s) in your plan!

Explore

- Observe the planning process noting whether they use the left and right arrows to turn or use them as a combined turn and move forward card. They can plan out whatever makes sense to them as they will be the ones deciphering and executing their plan.
 - Once they are done planning ask: *Okay do you have any questions before you start?* Answer student questions about the rules of the activity, ensuring they understand they need to use a tunnel before getting to the cheese.
 - Take pictures of student codes for documentation before they try out their code each time
4. **Trying.** Assign a student to represent the mouse and have them stand on the green spot facing the direction shown in the map image in the unplugged version (Also available at the end of this lesson).
- Say: Now it's time to use the plan you just finished to find the cheese. Make sure you are following every step of the directions you created!*
- Observe the student process of interpreting and carrying out their plan, noting how they use the turning arrows specifically and any direction words they use to describe using the tunnel.
 - They need easy access to their plan to follow the directions they created to get to the cheese. Another option would be to have a friend read the directions to them as they follow these directions while walking the green blocks.
 - **A backup option, if students create a plan but don't follow it when they act as the mouse,** is to have them devise a plan using the arrow cards that you, as the teacher, follow (as the mouse) exactly based on the arrows tell you to do. This could remove the risk of students misinterpreting the direction cards to ensure they have a correct forward path to reverse in part 2.
5. **Asking questions based on students' actions.**
- If students followed their plan but did not use the tunnel
 - Encourage students to use the tunnel and observe how they debug their code to account for the tunnel
 - *Say: You have a good plan to get to the cheese. There is a part of the instructions you forgot, though.*
 - *Ask: Do you remember the rules I gave you at the beginning?*
 - *Say: You must use the tunnel before getting to the cheese. Look at your plan to make sure your directions include the tunnel. Let's try it again!*
 - **Help students incorporate the tunnel into their directions as this needs to be a part of their plan to understand their knowledge of the computational thinking components we are interested in for the reverse portion of the activity**
 - If students followed their plan but did not get to the cheese

- Ask: *What ended up happening when you followed your plan? Why didn't you get to the cheese? How can you fix the mistakes in your plan so you can use them to find the cheese?*
 - Help students debug, so they can use the tunnel and make it to the cheese if they use their plan as they interpret it
 - Ask: *Okay, are you ready to try following your directions again?*
Depending on how students approached the debugging process, they can start from their current spot or start back at the beginning
 - If students did not follow their plan but completed the task
 - Ask: *How did you end up using the tunnel to find the cheese? Did you follow the directions you made in your plan?*
 - Students may be satisfied with the plan they came up with but try to encourage students to compare the path they took to revise their directions. The goal is to end up with a plan at the end of part 1 that works to accomplish the task, so students have a starting point to work off of for part 2 when they reverse.
 - Say: *Okay, you were able to use the tunnel and find the cheese but let's try to change a few parts of the plan, so it matches the path you took!*
- **No matter what steps students take, try to get to a point where how they interpret their plan gets them to use the tunnel and find the cheese. This will help set up the computational thinking aspects we are focusing on in part 2.**
- If the students successfully use the tunnel and get to the cheese using their plan, they can move on to the reverse activity.
- Take a picture of student codes for documentation
- Say: *Congratulations! You created a helpful plan and followed the directions to get to the cheese! Now it's important that you remember your position because the next part will be trying to get back to where you started.*
- ◆ If you have velcro available, you can adhere the cheese to the student's mouse placard so they can carry the cheese back to its starting place.

6. Introducing Part 2: Reverse

- Ensure students have their previously developed directions handy from the forward activity to work off of during the reverse activity.
- If other students were helping to create the tunnel and there is still time, each student can do the forward task as the mouse before attempting the reverse task to get a break. Alternatively, one student at a time could do the forward and then reverse tasks back to back. If switching between students, just reiterate that everyone needs to try to remember where they started and finished the forward task.
- Say: *Now that you used the tunnel and got to the cheese, it's time to figure out how to get back to the starting point. Think about how you can change your plan to follow your directions to get back to where you started, and don't forget about having to use the tunnel again! Do you have any questions before we start?*

7. **Planning.** Answer student questions about the task, then direct students to adjust their plan with coding cards before they start moving. Do not forget to take pictures of student codes for documentation before they try out their code each time.
Say: Before trying to find your way back to the beginning, look at your plan and figure out how to reverse it, so you end up where you started. Like before, you must use the tunnel before you can return to your starting place! Once you develop your new plan, you can follow those directions to use the tunnel and return to your starting place.
- Observe the planning process and note any direction words students use as well as whether the students flip the entire plan or code the whole thing again. **As the students should all start from a valid path as they interpret it, this piece is important for understanding how they reverse their plan. Without the literacy component from Joey and Jet, this activity can show what the students know about the reverse sequencing aspect of computational thinking.**
 - **Note how they use the arrows corresponding to turns, as the plan cannot simply be flipped, especially with the tunnel portion of the map.**
 - When students are done revising their plan, direct them to follow their directions to get back to the beginning.
8. **Try.** When students are done revising their plan, direct them to follow their directions to get back to the beginning.
- *Say: Now it's time to follow your directions, so you use the tunnel and end up back at your starting place!*
 - Observe the student process of following their plan, including the direction words they use.
 - Between their plan and the execution, students may reverse the coding card order sequence but not realize they have to change the arrows when they do so (like down instead of up and left instead of right).
 - Alternatively, they could recode the entire thing when they realize simply reversing their plan does not give them the desired results. **This piece is the key to understanding what the students know about the computational thinking competency in this activity. After the correct path has been established with the cards and code, there are correct ways to reverse it, and this piece tests the student's ability to do so.** Note where students tend to get stuck as well as points of understanding.
9. **Debugging.** Follow the examples below on how to ask questions based on student actions:
- If students don't use the tunnel, try to flip the entire forward plan front to back without changing anything else, or just don't accomplish the task in general:
 - *Say: When you followed your plan it didn't get you back to the starting place.*

- Ask: *How can you adjust your plan, so you have the right directions to use the tunnel and get to where you started?*
 - If students simply flipped the plan without turning around or reversing the arrows, ask: *why didn't it work when you flipped your whole plan front to back even though you didn't change anything else?*
 - Observe the debugging process noting if students realize that simply flipping the planning front to back without flipping the arrows does not work as desired.
 - Say: *Okay, now that you have adjusted your plan, let's try to follow your directions again and see if that gets you first to the tunnel and then back to your starting place.*
- If students accomplish the task using a completely new plan, try to find out how students interpreted the task:
 - Students may have separated the reverse task from the forward one, not realizing that the sequence they were starting with could have been used to work from
 - This is similar to students who don't use their plan as directions to get back to the beginning. There are parts of the process that they do not connect.
 - Say: *You did a great job using the tunnels and returning to your starting place! Is there anything you noticed about the paths you took to get to the cheese and then return to the starting place? Are there similarities or differences between your plans?*
 - Note any connections they make between the two tasks
- Take a picture of student codes for documentation
- Once students get back to the start and talk through their process, say: *You did a great job helping solve the problem by using the tunnels to get to and from the cheese. Thank you for helping me out today!*

Summarize/ Explain

1. **Wrap up.** Say: *Today, we read the story of a mouse called Anatole and his family. Every evening he used to bicycle with his friend, Gaston toward Paris to find food for their families. One night, while looking for leftovers in someone's kitchen, Anatole heard people talking about how terrible mice are! They sneak into the kitchen and take what is there, they said.*
 - Ask: *Do you remember how Anatole felt when listening to these words? Who can tell us the solution Anatole found to make up for this?*
 - Listen to the children's answers and remind them how they helped Anatole to take cheese to his family.
 - Ask: *Does anyone remember what we did to help him to get cheese for his beloved family? What happened when you, as the mouse, tried to return through the same path? Did you have to make changes in the sequence of the arrows? Why?*

The teacher can walk students through the activity and go back to the piece where the

teacher explains the trick about the reverse part.

**Apply/
Extend**

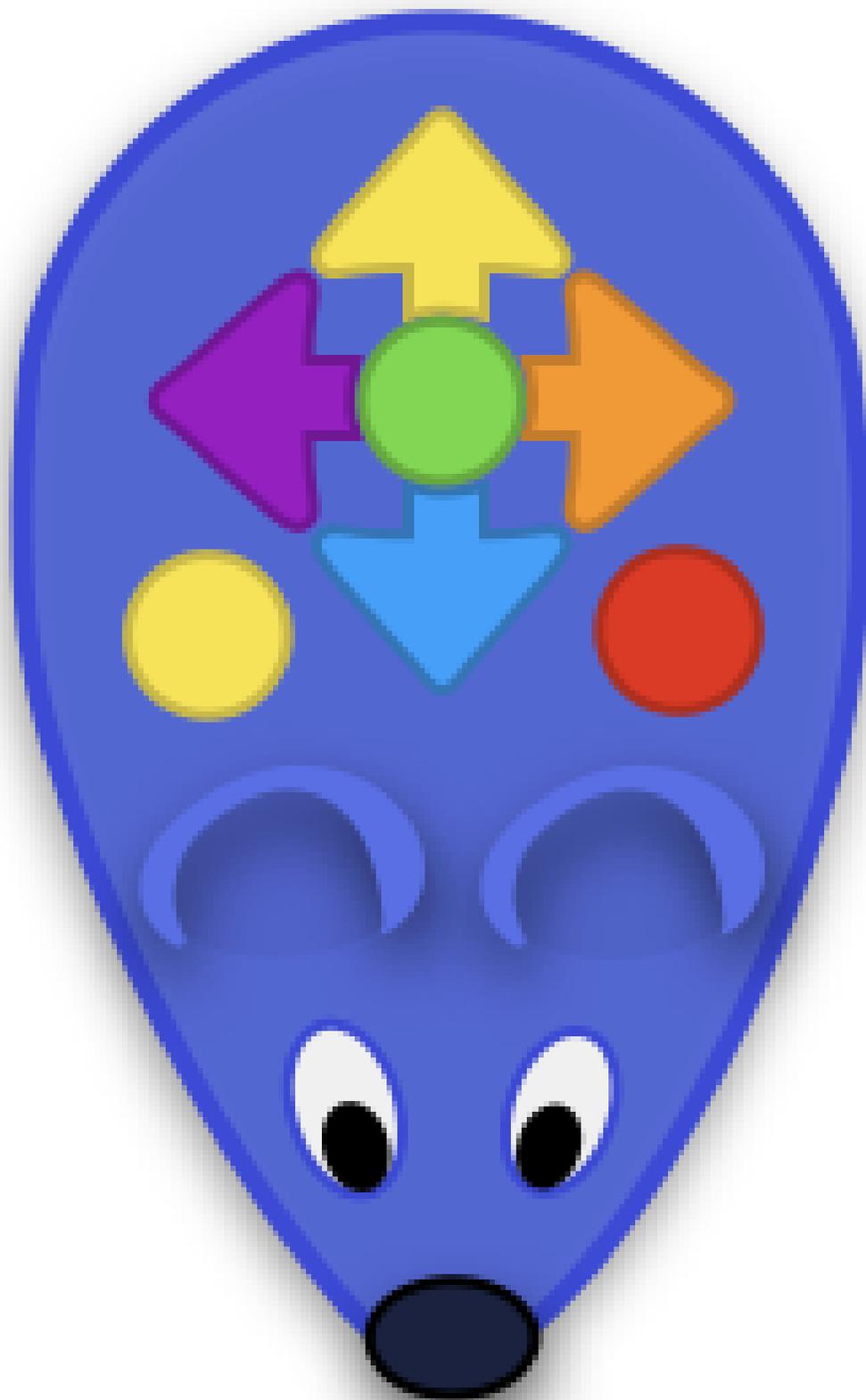
You can also ask students to work in pairs when student A works on the plan portion, and then student B follows student A plan. **Another idea** is having students create the sequence when the teacher follows the sequence. **Another suggestion** is to ask them to tell what they usually do when they wake up before arriving at school:

Ask: Do you have a plan before arriving at School? What do you usually do before getting there? What if you change the order of these events? - i.e., instead of waking up and eating, you first brush your teeth and eat after that? Or what if you take the school bus before getting ready for school? What would happen? What would be the logical order in this situation? Why?

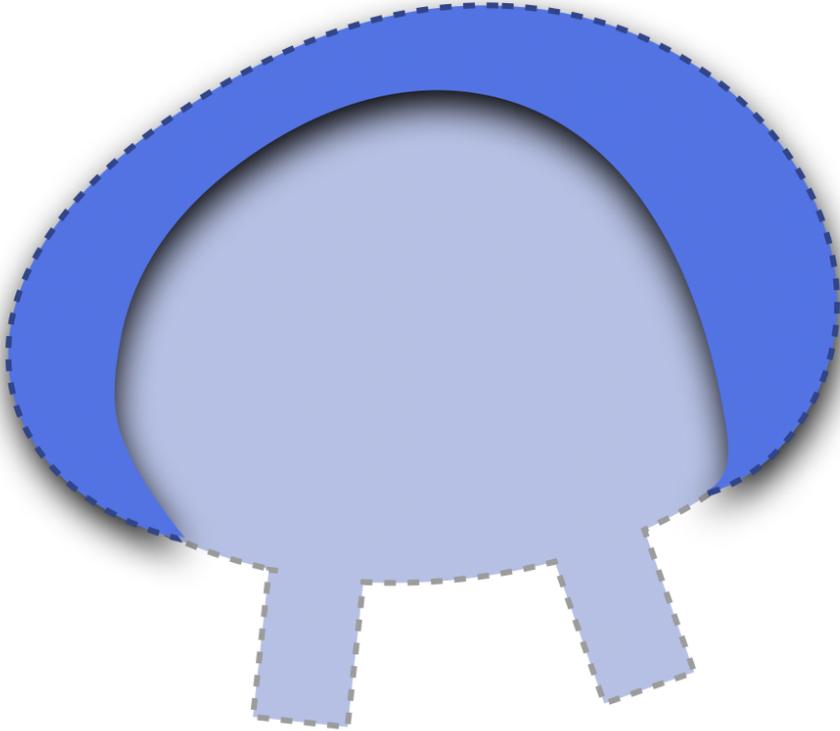
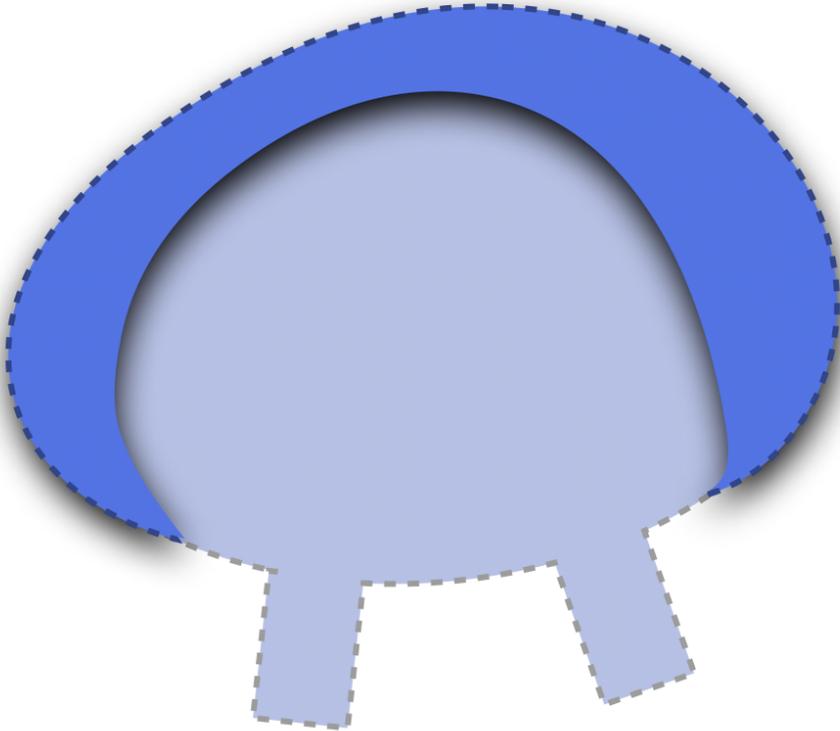
Teacher Notes

Printout Materials

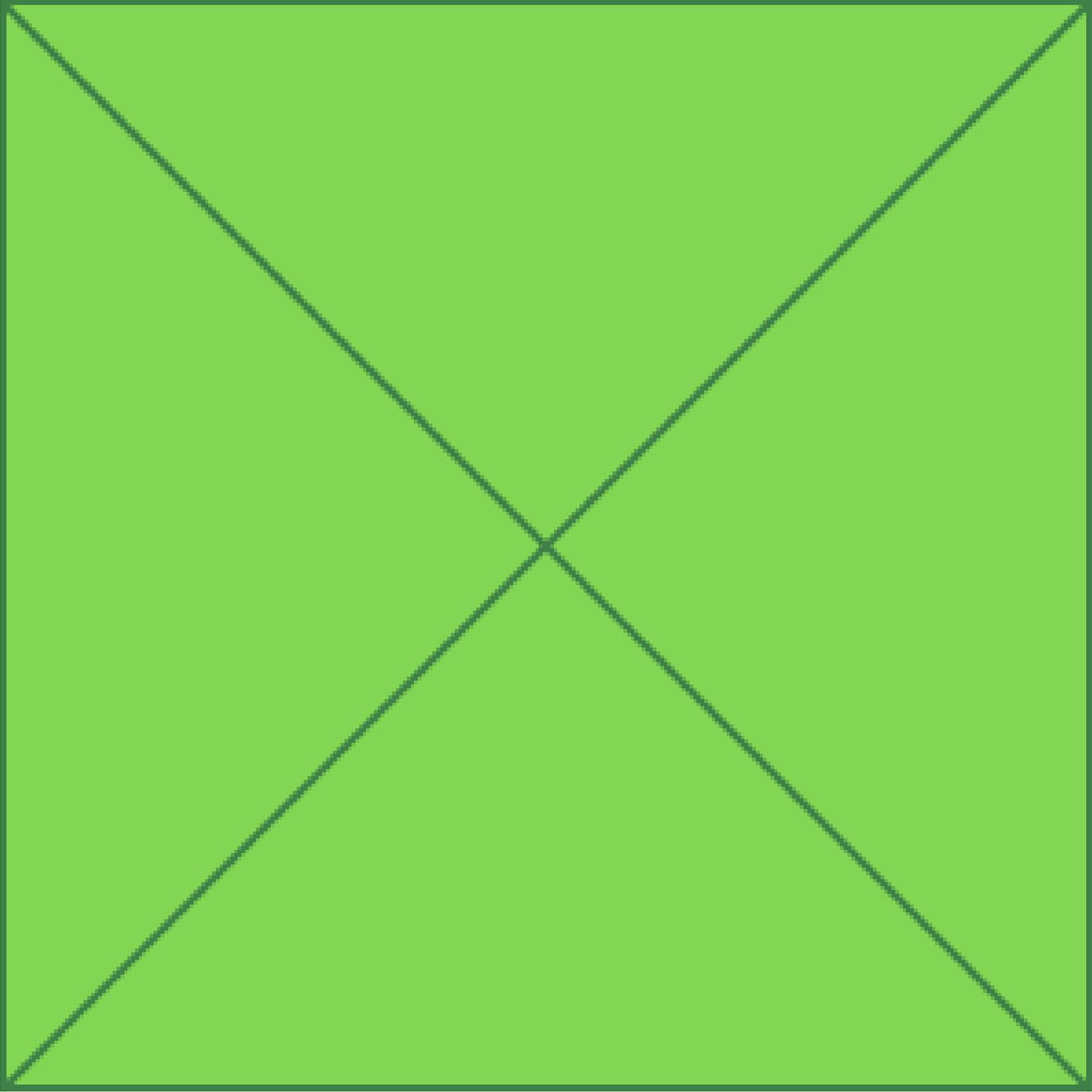
The Mouse (Option 1)



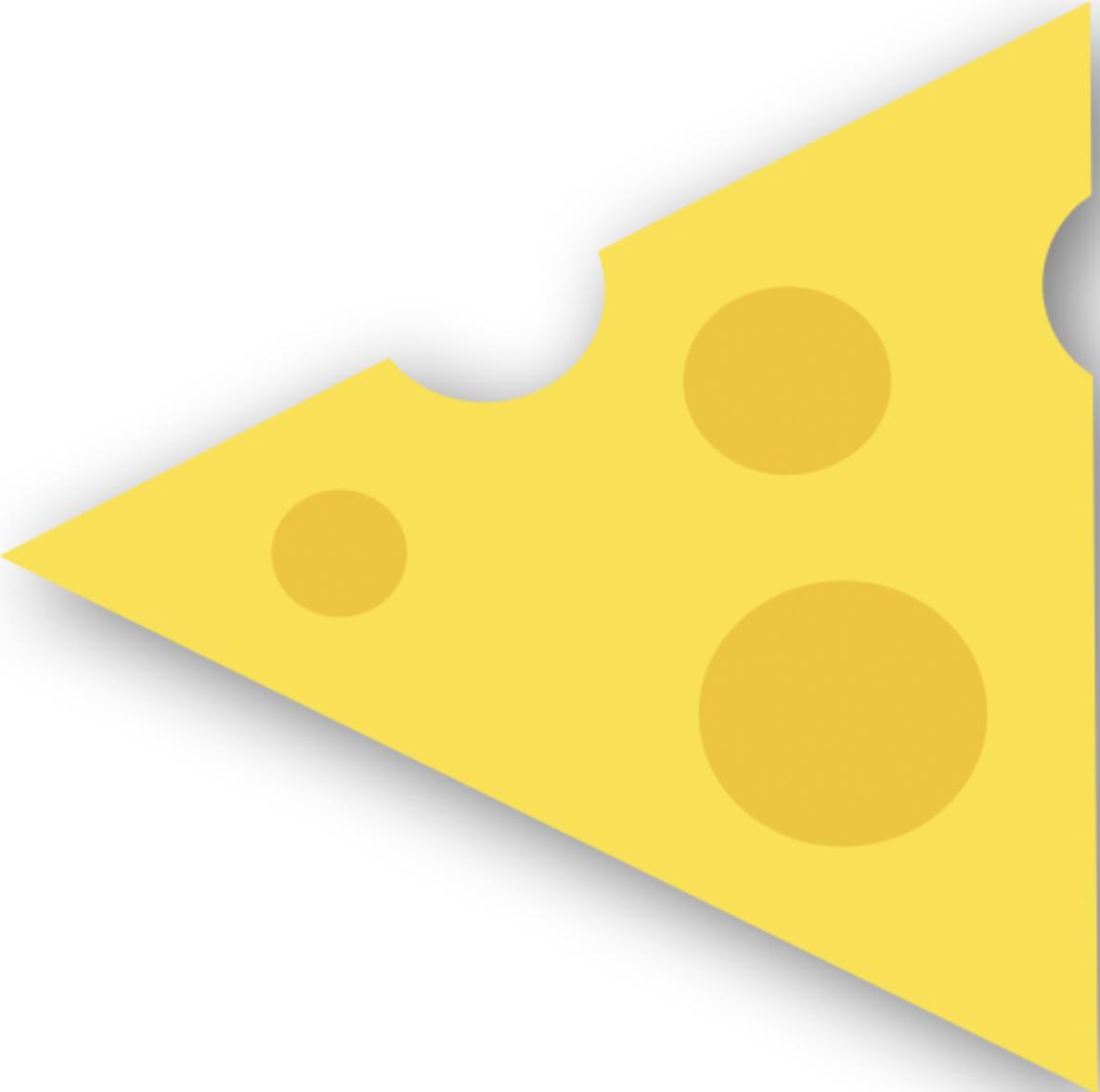
Option 2: Mouse's ears



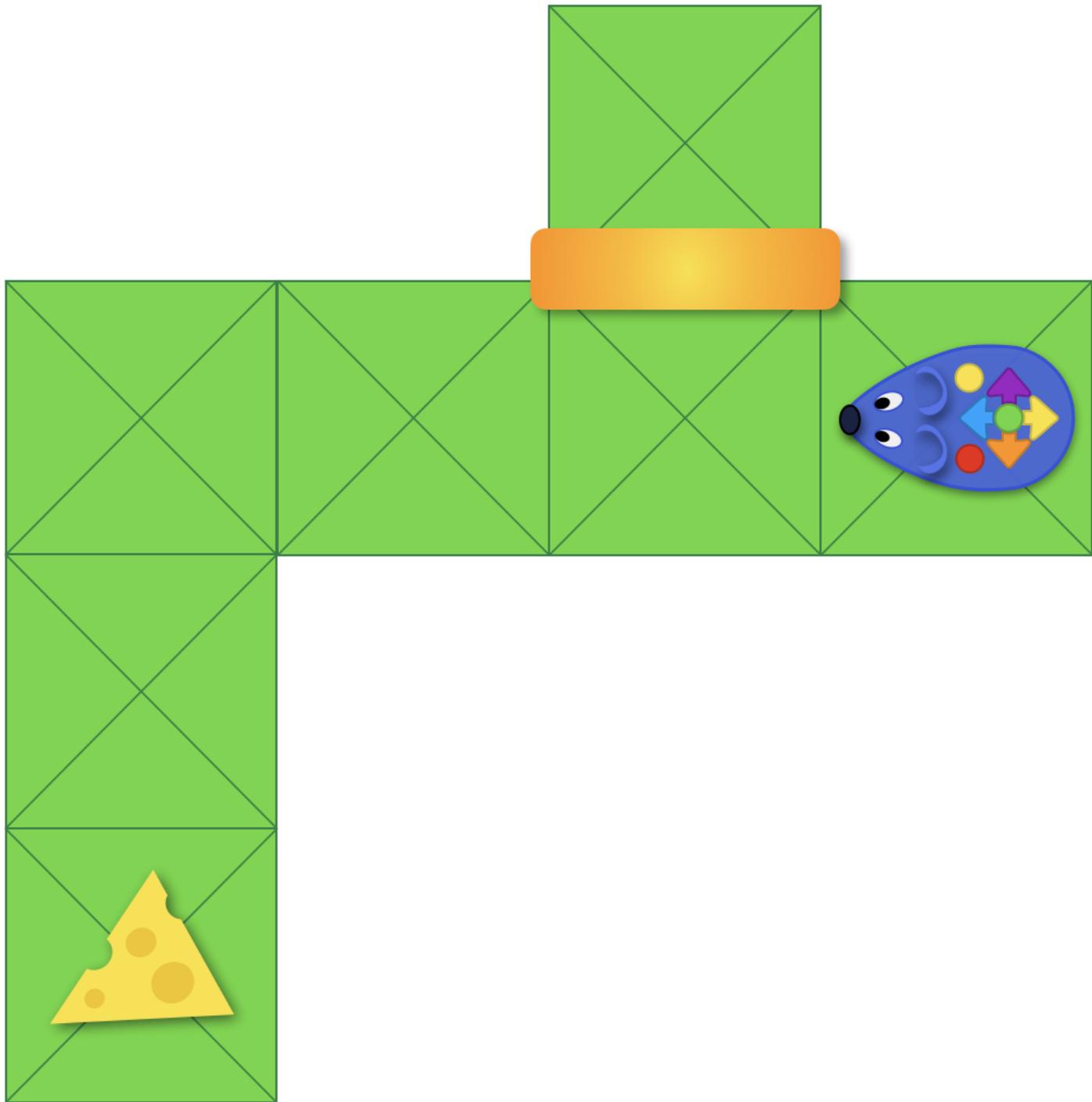
The Green Block (Print 7 copies)



The cheese



The map



Rethinking Circle Time

Sequencing/Conditionals:

Reverse Sequencing + Literacy: Joey and Jet



Lesson Summary	In this literacy and CT lesson, students work on prepositions and sequencing in a story using the book <i>Joey and Jet</i> by James Yang. This book takes students through a game of fetch from the perspective of the dog, Jet. Students sequence the actions from the story, reverse the sequence, and learn preposition words.
Grade Level	K-2
Subjects Addressed	Literacy, Computational Thinking
Standards	<ul style="list-style-type: none">● CCSS-ELA:<ul style="list-style-type: none">○ RL K.2, K.3, K.7; L.K.1.E; SL.K.6○ RL.1.2, 1.7; L.1.1.I; SL.1.1○ RL 2.5, 2.7;● CSTA: 1A-A-5-3
Learning Objectives	Students will be able to: <ul style="list-style-type: none">• Literacy: use prepositions to describe actions. Use flowcharts to organize the sequence of events in a story.• Computational Thinking: Algorithms & Procedures: sequence the events of the story using a flowchart.
Teacher Background and Content Information	<p>Prepositions: Words that show relationships between objects in a sentence. The prepositions in this lesson are all related to spatial relationships. Prepositions from the book: among, through, on, down, up, across, between, over, into, out of</p> <p>Sequencing: Sequencing is both a reading strategy and a computational thinking concept. In computational thinking, sequencing is a part of the idea of algorithms. Algorithms are step-be-step, ordered procedures to accomplish a task. Students must learn to create directions so that a machine can follow them and produce the intended result. This activity is meant to explore the idea of sequencing both for the purpose of retelling the story and to explore the students' ideas of reversing directions as a computational sequencing strategy.</p> <p>Note that reversing the original sequence in the story is not simply a one-to-one reversal. There is higher-order logic involved. In the first direction, Jet (the dog) chases the ball "down and hill" and then "up a hill" and also "into a hole" and then "out of a hole." When the whole sequence is reversed so that Jet takes the ball back to Joey (his boy), these two pairs will still be in this same order logically (because one cannot come out of a hole before they have gone into the hole). This is one of the fun parts of this activity – watching the students think through this logic.</p>

	Reading strategy: Sequencing to help retell events of the story
Differentiate/ Inclusion	<p>How will this change for lower grades? How might this change for upper grades?</p> <p>For lower grades: Get rid of prepositions, make hill and hole one event, and shorten the flow chart.</p> <p>For upper grades Encourage students to use long sentences to retell the story. Recreate a similar story. Include written activities.</p>
Materials	<ul style="list-style-type: none"> ● <i>Joey and Jet</i> by James Yang <ul style="list-style-type: none"> ○ Note the reverse sequence page in the book is in the wrong order - it needs to be down the hill, then up the hill - make a color copy of those two panels and switch the order (you can just paste this in the book permanently). ● Flowchart -Jet Chases and Flowchart - Jet Returns placemats for each student. Lamination is recommended for reuse. ● One classroom Flowchart-Jet Chases for demonstration ● One set of Jet Preposition Cards for each student. Lamination is recommended for reuse.

Overall Description

Launch/ Engage	<ol style="list-style-type: none"> 1. Discuss prepositions as a part of speech. Gather the students for a “Read Aloud”. <i>Say: Before we begin reading our book, let’s play Simon Says. This game will prepare students to listen for the prepositions in the book and words to use for giving directions. Give several directions using prepositions from the book - examples: put your hands on your head, put your right arm out, etc.</i> <i>Say: Simon gave you directions to follow. Tell me some of the words that helped you follow my directions? Post the preposition words they say on the board, interactive whiteboard, etc. Make sure to use some or all of the following prepositions: among, through, on, down, up, across, between, over, into, out of.</i> 2. Introduce the literacy skill – describing major events in a story using flowchart retelling. A flowchart is a way to help students think about the sequence of key events in a story. By placing each event in a rectangle and connecting them with arrows, this graphic organizer helps students to organize their thoughts as they retell a story. <i>Say: We are going to learn about using flowcharts as a way to keep track of what happens in our story today.</i> Explain flowcharts to the students. Put a sample flow chart on the board. Explain how a flow chart works and why it helps retell the important events in a story. 3. Introduce the book. <i>Joey and Jet</i> by James Yang. <i>Say: This is a story about a boy named Joey playing fetch with his dog, Jet. We are going to try to remember what Jet is doing while he is chasing his ball so we can retell the story.</i>
Explore	<ol style="list-style-type: none"> 1. Read the first part of the story aloud. Stop reading when you reach the page that says “out of a hole!” (about $\frac{3}{4}$ of the way through the book). While reading, guide the literacy learning <ul style="list-style-type: none"> ● Teach prepositions at the point of contact: Tell students to raise their hand when they hear a preposition that matches one on the board. You can point out that all the preposition words in the book are written in bold so they can recognize them when you show the pictures.

- Target story comprehension: As you read, help students remember the steps that Jet goes through to get the ball. Review this as you progress through the book.

2. **Work on prepositions.** Give each student a set of preposition cards. Have the students fill in the correct prepositions by writing it on each card.
3. **Flowchart the beginning of the story.** Have the students return to their desks for the flow chart activity. *Say: Now we are going to retell the story of Joey and Jet by using our cards.* Have students do the following:
 - a. Have students put the cards in the order that Jet did each action as he chased the ball. You may need to review the story with them as they do this.
 - b. Give each student a copy of the Flowchart – Jet Chases placemat. *Ask: How many rectangles do you see on your flowchart? Do you see anything else on the flowchart?* Take answers. Ask them what the arrows mean. *Say: Look at each card and think about our story. Now you can retell the story by placing a card on each rectangle in the same order it happened in the story.* Have the students check their flowcharts as you reread the first part of the story (Jet chasing the ball).
4. **Flowchart the rest of the story before reading it.** *Ask: What has just happened in our story? Jet has reached the ball. Ask: What has to come next in the game of fetch? Jet has to return the ball. Say: We are going to try to figure out what actions Jet will have to take to get back to Joey.* Pass out the **Flowchart – Jet Returns** placemat. Have students try to order the things that Jet will have to do to get back to Joey. Have students check their work as you read the final part of the story.
NOTE: The return flowchart is not simply the reverse of the chase flowchart. Jet must again first go into a hole, then out of a hole. The hills are not in the correct order in the return trip in the book (Jet should go down, then up the hill). Accept both directions for the hill.

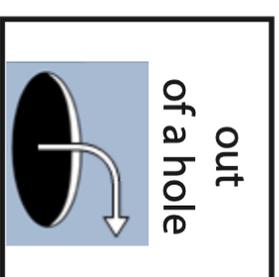
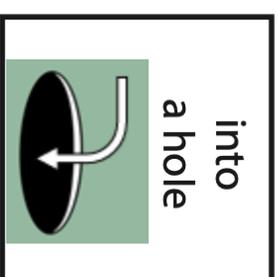
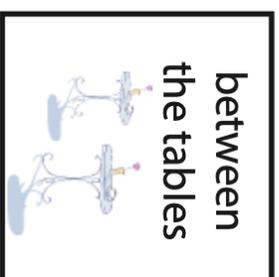
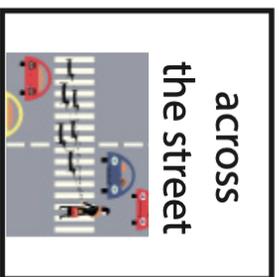
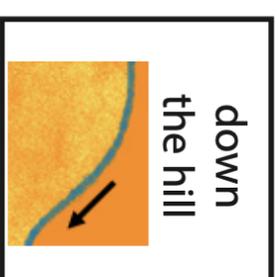
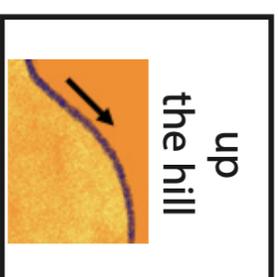
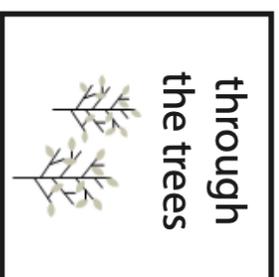
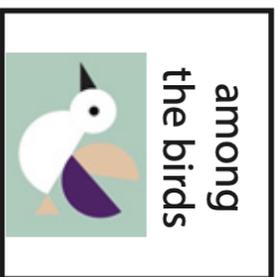
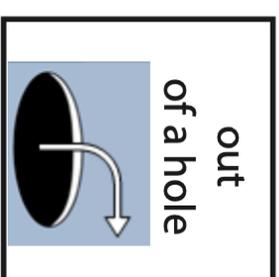
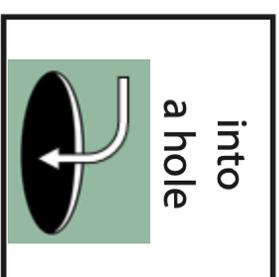
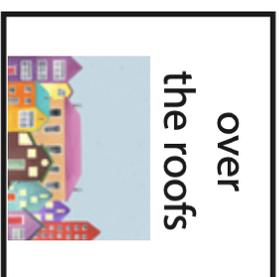
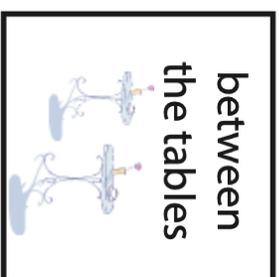
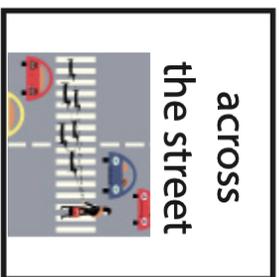
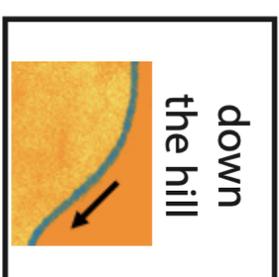
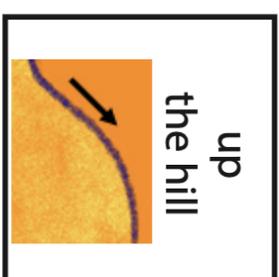
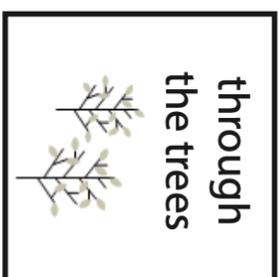
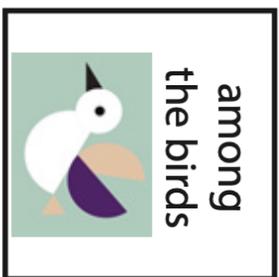
**Summarize/
Explain**

1. **Review the steps Jet had to take to get to the ball and to return it to Joey.** *Ask: Was any part of reversing Jet's action difficult for you? Why?* Take answers - highlight higher-order thinking skills needed to reverse the hill and holes.
2. **Review the structure of the story.** Ask students to remember the whole story. What started the story, what happened in the middle of the story, and what concluded the story. Also that the structure is repetitive

**Apply/
Extend**

1. **Have students make flowcharts for the events of other stories.**

Teacher Notes



Flowchart – Jet Returns

Jet found his ball and ran...

