The Double-Decker Bus

We are about to start *The Double-Decker Bus*. This unit is designed to provide opportunities to use the 20-bead rack as a model to support the automatization of the basic addition and subtraction facts to 20. It begins with a read-aloud story of the same name. The book is available from www.NewPerspectivesonLearning.com if you wish to purchase it, but the story is also provided free in the set of Appendices, marked Appendix A.

This unit also makes use of a 20-bead mathrack. If you prefer to purchase the rack and work with your child in real time off screen, it is available at www.mathrack.com. But, you can also use a free online app. This is the link for the online rack tool. https://apps.mathlearningcenter.org/number-rack/

You will also need Appendices A-N.

Activities for Week One

Investigation #1: The Double-Decker Bus

- Start by reading the story *The Double-Decker Bus.*
- As you read, stop periodically to discuss the number of passengers on the bus. Be sure that your child understands the context—that double-decker buses have two levels and that passengers can go up and down the stairs from one level to another. When you finish reading the story, display the mathrack and point out that the rack has two decks just like the bus, and that the beads are in two colors to make it easier to figure out how many beads there are. Explain that the rack can be used to tell stories of passengers sitting in the red and white seats on the bus. The colors will be helpful in figuring out how many passengers are sitting in the seats.
- Pretend you are the bus driver. Pick a number and slide that number of beads to your child's left side so that he sees the red beads first. Cover the other beads. An example for the number 13 is shown below. Other arrangements for 13 work, too.

- Ask your child to pretend to be a child looking at the bus, like the little girl in the story. Ask, "How many passengers are on the bus if they are sitting in these seats?" Suggest she think of the two colors as seats to help her do it quickly

before the bus passes. She might say 5+5+3, as a fast way to see 13, or she might say 7+6, or 6+6+1. All of these are great ways to get an answer quickly. Counting of course works, too, but it is likely a strategy that will take too long. The bus will be down the road before the counting is finished. Support your child to use the five red seats to determine the number without needing to count.

- Have your child record what she sees on Appendix C. For example, she might write 13 for the number of people, and then 5+5+3 if that is how she saw it.
- Alternate roles and do a few more situations with different amounts.

With your cell, take a picture of your child's work and send it to your child's teacher. If you like, you can also send it to a few of your child's friends and they can FaceTime to talk about their work.

> The teacher will likely arrange to talk to your child about his work and may hold a meeting with small groups of children online—a math congress—to have some children talk about what they saw and how the colors of the seats helped.

Minilesson #1: Quick Images (10–15 minutes)

This minilesson uses a string of related quick images (shown briefly and then covered) to support the use of the group of five. Briefly display an arrangement of beads on the rack, and then cover it with the board or a piece of cloth. Give time to think about it, and then ask, "How many did you see?" [Note: Show the images one-at-a-time, long enough to allow your child to see the groups of five, but not long enough for him to count beads individually; this time constraint encourages a shift to strategies that are more efficient than counting.]

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String of Images

Five on the bottom
Five on the top and five on the bottom
Six on the bottom
Eight on the bottom
Seven on the bottom
Ten on the top

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Investigation #2: Hard and Easy Arrangements

Remind your child of the double-decker bus story and how the girl in the story tried to find quick ways to figure out how many passengers were on the bus before the bus pulled away. Recall that the same number of people can sit in different arrangements on the bus, some on the top deck and some on the bottom deck. Ask your child how the bus might look after eight people board. Explore a variety of ways to make 8 on the rack, then ask

which arrangements would be easy for the girl to see and know 8 passengers are on the bus, and which would be harder. Have a discussion about what makes it easier to figure the total for some arrangements, and what makes it harder to figure the total in others?

Choose some numbers to try. Encourage her to use the groupings of five. Use the recording sheet (Appendix E) to record.

Note:
In deciding easy or difficult arrangements of "passengers", children who are still counting every bead might say that there is no real difference—after all, they have to count in each case. Children using groups of five and ten however, will find that it is easier to figure the number of passengers when the five-structure is apparent in the arrangement. Combinations like four on the upper deck and eight on the lower deck might be considered difficult because no groups of five or ten stand out on their own—i.e., the one full group of five is nested within the eight. In contrast, one full row is easily seen as 5+5 = 10, and the two red beads left on the bottom are easily seen as a group, too, because the amount is so small. The purpose of the activity is to build sets of equivalent arrangements: 8+4 = 10+2. Doing so, supports the development of getting the basic facts automatic.

With your cell, take a picture of your child's work and send it as an attachment in an email to your child's teacher. If you like, you can also send it to a few of your child's friends and they can FaceTime to talk about their arrangements.

The teacher will likely arrange to talk to your child about his work and may hold a meeting with small groups of children online—a math congress—to have some children talk about what they drew and why.

Games #1 and #2: Passenger Pairs and Rack Pairs

Object of the Game
The purpose of the game is to encourage children to examine different ways the same number of passengers can be seated, and to explore why it is easier to recognize the totals in some arrangements than in others.

Directions for Playing
Cut out all the cards provided on Appendix E. The Passenger Pairs deck includes 24 cards with different arrangements of bus passengers (twelve pairs of cards depicting the same number). Place the cards face up, in four rows of six. (The sun in the top left corner helps children orient the cards correctly.) Players take turns finding two cards that depict the same number of passengers. Player #1 picks up two cards, states the number shown, explains how she knows, and asks Player #2 for agreement or disagreement. If Player #2

agrees that the two cards each show the same number of "passengers", then the cards are placed in a discard pile. Then Player #2 takes a turn selecting two matching cards. In all

> **Note:**
> There are two versions of this game: Passenger Pairs contains the easy set of cards (Appendix E), with 24 arrangements of "passengers" on a bus. Rack Pairs contains a more difficult set of cards (Appendix F), with 24 cards depicting beads on the rack. In Rack Pairs, the context of the double-decker bus is implicit rather than explicit, and the arrangements of numbers of beads make recognition of the totals shown on each card more difficult to figure as well. Children who easily recognize the totals depicted on the Passenger Pairs cards should be encouraged to try Rack Pairs.

cases, the partners must agree whether the totals on the cards match. The matching pairs are placed in one discard pile, encouraging collaborative rather than competitive play.

Investigation #3: Finding All the Arrangements

Remind your child of the section in the double-decker bus story where the wind and rain sent passengers from the upper to the lower deck. Consider that the reverse might also happen: if the weather got warmer or sunnier, passengers might be tempted to go from the lower deck to the upper. This sets the stage for the introduction of two important math ideas: compensation and equivalence—that rearranging objects between two groups will not change the total number of objects.

Ask your child to show on the rack five "passengers" on the upper deck and seven on the lower deck. Ask what happens when a passenger goes downstairs. These ideas should emerge:
- One number decreases from five to four, while the other number increases from seven to eight.
- The total number of passengers, twelve, does not change.

Now ask your child to predict what the numbers would be if another passenger goes downstairs, and then what would the numbers be when yet another passenger goes downstairs? What about when two or three passengers move between decks? Check predictions on the rack and use numerals to record your findings. For example, write:

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5 on the top   8 on the bottom
6 on the top   7 on the bottom
7 on the top   6 on the bottom

</div>

Ask if any patterns in the numerals are occurring, and why. Help her note that the non the top are going up by one, and the numbers on the bottom are going down by one. Lastly, ask if all the possible combinations have been done, or if there are more. Help her to work systematically to find all the possibilities, but let her take the lead.

Note:
In this investigation, children are being asked to find (and list on paper) *all* possible ways a number of passengers can be split between the upper and lower decks. Allow children to organize their ideas in their own way; do not try to organize or systematize their work too early in the investigation. In this context, the emphasis is on compensation and equivalence. Using numerals instead of drawings of beads to record the number of people on the upper and lower decks will help children move away from counting each bead one by one.

With your cell, take a picture of your child's work and send it as an attachment in an email to your child's teacher. If you like, you can also send it to a few of your child's friends and they can FaceTime to talk about their strategy.

The teacher will likely arrange to talk to your child about his work and may hold a meeting with small groups of children online—a math congress—to have some children talk about what they drew and why.

Minilesson #2: Quick Images (10–15 minutes)
Show and discuss a few more quick image arrangements of beads on the rack, each time asking your child what he saw, and how many there were all together.

String of related quick images

7 on the top and 3 on the bottom
6 on the top and 4 on the bottom
5 on the top and 5 on the bottom
8 on the top and 4 on the bottom

Note:
The images shown in this string support the development of compensation. The first three problems all have the same answer and are illustrative of just one passenger going up or down. The last image challenges children to consider 2 going up to the top deck: $8 + 4 = 10 + 2$.

Minilesson #3: Quick Images (10–15 minutes)
Show and discuss a few more quick image arrangements of beads on the rack.

String of related quick images

6 on the top and 3 on the bottom
3 on the top and 6 on the bottom
5 on the top and 8 on the bottom
8 on the top and 5 on the bottom
7 on the top and 3 on the bottom
3 on the top and 7 on the bottom

Note:
The images shown in this string support the development of the commutative property of addition—that the numbers can be reversed but the total remains the same. The string consists of three pairs. The problems in each pair result in the same total number of upper deck plus lower deck "passengers". As you proceed through the string, no matter what strategies your child is using, the pattern in the answers will become apparent and the "switching" can be discussed. You can also ask if the total always remains the same if the numbers of upper- and lower-deck passengers are just switched.

Investigation #4: How Many Passengers

Reread this section of the *Double-Decker Bus story:*

> *I like it when Daddy tells me about the buses. "Sometimes," he says, "when people get on the bus, they ask if there are any seats up top. But I can't tell them because I can't see up there." I helped him figure it out. I told him if he knew how many people were on the bus altogether, he could just subtract the number of people he could see on the bottom. Then he would know how many were on the top deck. He liked my idea and he tried it.*
> *"This morning," he explained, "I knew that eight passengers had boarded the bus. And I saw just two of them sitting behind me downstairs. So, I figured there were six sitting upstairs. I know there are ten seats upstairs, so I was able to tell a lady who asked that there were four empty seats on top."*

Ask your child if she can paraphrase the bus driver's thinking. If not use the rack and model this section of the story with it. Then provide your child with the recording sheet (Appendix J). For each picture on the page, ask her to investigate how many empty seats there are on the lower deck and on the upper deck. Ask her to explain a strategy that would help the bus driver figure out how many empty seats there are on the top without going up.

With your cell, take a picture of your child's work and send it as an attachment in an email to your child's teacher. If you like, you can also send it to a few of your child's friends and they can FaceTime to talk about their work.

Activities for Week Two

Minilesson #4: Quick Images (10–15 minutes)

On the rack, show only numbers on the upper deck. Show the image briefly—long enough for your child to see the beads but not long enough for counting each individual bead. For each image, ask, "How many beads on the upper deck are missing?"

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String of related quick images:
3 on the top
7 on the top
2 on the top
8 on the top
6 on the top

</div>

Note:
The first four problems are paired to accentuate the relationship between addition and subtraction and to support children in using either adding on or removing strategies but with the five-structure intact as an image. The last problem has no pair, requiring children to think of it on their own.

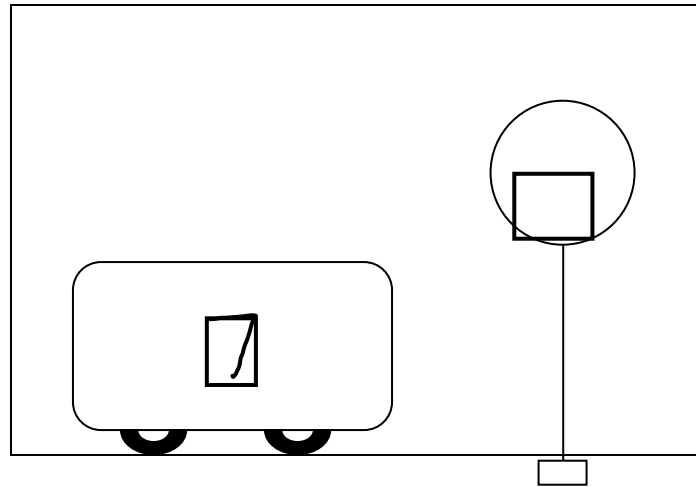**Games #3 and #4: Bus Stop Addition and Bus Stop Subtraction**

Remind your child that the bus driver in the story wanted to keep track of the number of passengers on the bus so he would know how many empty seats there were on the top deck. Describe the following scenario:

> *One morning, a bus driver started a bus route and twelve passengers got on the double-decker bus. The bus driver knew that because he saw six going to the upper deck and six to the lower deck. At the second stop, four more people came on the bus. He wondered how many passengers were now on the bus.*

Ask your child to model the situation on the rack and explain how he knows it is 16. Ask him if he is using an easy way. Then continue the bus story with a second example:

> *He made several more stops and people got on and some got off the bus. Later in the day, he noticed that there were seven people on the bus and at the next stop five people got on.*

Use a blank Bus Stop game card (Appendix K). Write "7" on the bus and "+5" on the bus stop sign, explaining that this number shows what happened at the bus stop. Tell them that these cards will tell bus stories in a new game they will learn.

Object of the Game:
The purpose of the game is to encourage children to examine a variety of ways that the same number of passengers can be seated and to explore how some arrangements of passengers are easier than others to recognize and that these arrangements can be very helpful when adding.
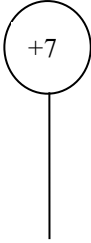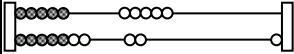
Directions for Playing:
Place the Addition Bus Stop game cards (Appendix L), face down in a stack. The number in the bus image tells how many passengers are on the bus as it approaches a bus stop. The round signs indicate the number of people at the bus stop, ready to enter the bus. Player #1 turns over a card, shows the bus scenario on the rack, and declares how many passengers are on the bus as it drives away. Player #2 takes a turn and play continues until the cards are used up.

Bus Stop Subtraction is played similarly except with the set of subtraction cards from Appendix M, which tell how many passengers got off at the stop. Remind your child to set up the number of passengers on the bus first in a smart way, so when the passengers get off the bus it is easy for the bus driver to know how many are still on the bus.

Investigation #5: Making a Bus Stop Storybook
Using the template provided on Appendix N, make a bus storybook with your child. This activity is a culmination to the unit. Make as many of these as you wish, folding the templates accordingly into a book, with the answer initially hidden. Spread them out and enjoy telling the stories to each other.

Sample bus story:

On the bus	At the bus stop	Our solution	Question
There are 12 passengers on the bus: 5 sit on top and 7 sit below.	The bus came to a stop and this is what happened. 7 people got on the bus. +7	Now there are 19 passengers on the bus.	(Fold over and write question on back) How many passengers are on the bus now?

With your cell, take a picture of your child's book and send it as an attachment in an email to your child's teacher. If you like, you can also send it to a few of your child's friends and they can FaceTime to read their stories to each other.

The teacher will likely arrange to talk to your child about his work and may hold a meeting with small groups of children online—a math congress—to provide time for children to read their books to each other.