Study 2
Patterning Script

The patterning and numeracy activities in this script created at Vanderbilt University was adapted from Clements, D., & Sarama, J. (2007). *Real Math Building Blocks PreK Teacher's Edition*. McGraw-Hill Education.
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**General Notes**

**Patterning Instruction:**

1. Gestures help children see the core unit and its repetition! See script. In general
   a. Within a core unit, use fingers on two different hands to point to different items.
   b. When transitioning to next core unit, pull hands away from pattern and take fingers down. Then, re-extend fingers to show items in next core unit.

2. Language helps children see the core unit and its repetition.
   a. Don’t use the word “and” within a core unit. (e.g., “one trapezoid, one square”)
   b. Always use the word “and” between core units (e.g., “one trapezoid, one square, and one trapezoid, one square…”)

**General Timing**

1. Make sure to leave 10 minutes for numeracy activities, this means cutting some pattern activities short (e.g., not doing extra pattern strips)
Session 1:

Pattern Duplication & Extension, +1 Rule

**Pattern Objective:** To recognize and duplicate repeating pattern

**Numeracy Objective:** To begin to understand the successor principle in addition with small numbers

**Materials:** Horse puppet, iPad, Pattern blocks, pattern strip, pattern strip booklets, tangram blocks, little bird packet, plastic bag with objects and felt

**Vocabulary:** A repeating pattern is a series of repeating units.
I. Billy in a clip/clop pattern (AB)

Materials Needed: Horse Puppet

1. Hello children! I brought a very special friend with me today. His name is Billy and he is a horse. Would you like to meet Billy the horse? (Bring out horse)
   a. Billy: Hello, boys and girls! Let’s take a trip to my home in a barn. Follow me!

2. When Billy walks, he goes clip clop, clip clop (while stomping each foot, emphasizing left, right, left, right stomp). Let's walk like Billy on our way to the barn! (Walk to training room, clomp like horses.)

3. Great job making clip-clop noises while we walked here! His sounds make a pattern because it has a part that repeats: “clip, clop” repeats over and over.

4. Can you think of something else that repeats over and over again?
   a. Book suggests: going to sleep, waking up, going to sleep, waking up (if the kids don’t give an answer)
II. Pattern Strips
Materials: AB Pattern Strip, Pattern Strip Booklets, Tangram blocks

IIA) INTRO: We are going to be pattern detectives. First, we will look for repeating patterns (make binoculars with hands and look around through them). Repeating patterns follow a rule that one part repeats over and over. When we say the pattern out loud, we can know what comes next. In math, we should always look for patterns.

Now I’m going to sing our pattern song, you can join me if you’d like! “Oh dear, what can the pattern be (x3) Let’s look at the pattern and see

IIB) Group (AB)
1. Show the children the first pattern strip (trapezoid/square - pg. 1 in pattern strip booklet) and ask: Can you describe the pattern?
   a. If they struggle, ask What shape do you see first? (Provide shape name if child doesn’t know. If needed: “what comes next”?)
      i. Goal is for children to name all items in the pattern from the beginning and learn to use this as a strategy to determine what comes next.
2. Now, let’s make the same pattern down here! What shape do we start with? What comes next? Copy using Pattern Blocks away from pattern strip: Chant pattern as you point to each shape
3. This is a pattern because it follows a rule. Let’s figure out the rule. It goes one trapezoid and one square point with one pointer finger from each hand then it repeats remove fingers & repeat gesture one trapezoid and one square, so the part that repeats in this pattern is one trapezoid hold up right pointer finger (pointing up), one square hold up left pointer finger. One trapezoid - one square repeating over and over is the rule!

4. Because it’s a pattern, we know what comes next. Let’s keep the pattern going. What comes next? (extend by one full AB unit)

IIC) Individual pattern booklet (AB, ABB, ABB, ABC, AABB)

1. I have new patterns for you to do.

2. Please make the same kind of pattern down here. (point to spot on booklet for each child. Pg. 2-6 in pattern strip booklet)
   a. If child is making an error: You can always say the pattern from the beginning to figure out what comes next! Have them recite the pattern from the beginning item by item so they can catch and fix the error.

3. Prompt to extend pattern by one core unit: Can you keep it going?
   i. Prompt again if needed to make one full core unit.
   ii. If child is making an error, have them recite the pattern from the beginning

4. Turn page and repeat copy and extend prompts for ABB pattern.
5. **Pattern Labeling**, using ABB pattern strip:
   
a. **Look, this starts with 1 square** Point to the square with the right pointer finger, **2 triangles that are the same** point to 2 triangles with 2 fingers from other hand and then it repeats (remove both fingers, then repeat gestures), **1 square** (square), **2 triangles** (triangles), and then **1 square** (square), **2 triangles** (triangles) (using consistent gestures throughout).

b. **So we can call it a 1-2 pattern** raise right pointer finger and left pointer and middle finger.

c. **What can we call it?** <A 1-2 pattern, repeat gestures>
   
   **Why?** <because 1 square and 2 triangles repeats over and over again>

6. Turn page and repeat copy and extend prompt for each pattern. Do not do pattern labeling for other patterns. Only do these additional patterns if time permits.
Session 1

III. Dancing Patterns (AAB)

Materials Needed: iPad with music

Now we’ll make patterns while we dance

Play: Go Noodle Pattern song in the videos app.
For session 1, stop song after “Banana, Banana, Meatball (54 seconds into video)

“Patterns in the air, patterns everywhere
Patterns made of shapes, patterns made of grapes
Patterns on a cheetah, patterns on my feet-ah
Patterns in an app, patterns in this rap
Make a pattern, make a pattern, let’s make a pattern, alright
Make a pattern, make a pattern, let’s make a pattern
Ok, here’s one.

Let’s make the pattern together again! Banana, Banana, Meatball (make pattern, with gestures, repeating core unit 3 times)

a. We made a pattern because it has a part that repeats, so we know what will come next. Can you describe the pattern?

b. Right, banana, banana, meatball repeats over and over!
IV. Reflect

We saw and heard patterns today. How do you know when something is a pattern?

1. <listen to answers. Conclude> Good thinking today. You know something is a repeating pattern if it follows a rule that one part repeats over and over, so you know what will come next.

We’ll keep thinking about how we know if something is a pattern
V. Numeracy: **Little Bird Story**  
Materials Needed: Bird Pictures Book

A) **INTRO:** Now we are going to look for rules in numbers! (make binoculars with hands and look around through them). Remember, patterns follow a rule and so do numbers. When we find a pattern, we know what comes next, when we count we can know what number comes next. Let’s start with a story.

B) **Tell Little Bird Story**  
Hold up a finger for each new bird. Try to get kids to guess the next # before raising new finger

One little bird with lovely feathers blue (Put up pointer finger right hand)  
Sat beside another one (Show second finger), then there were two  
Two little birds singing in the tree, another came to join them  
Then there were (pausing for children to predict) three (Show third finger)  
Three little birds wishing there were more, along came another bird.  
Then there were ................. four (Show fourth finger)  
Four little birds glad to be alive, found a lonely friend  
Then there were .................... five! (Show fifth finger)  
Five little birds picking up sticks, along came a helper  
Then there were .............six! (Show one hand and a finger on the other)  
Six little birds looking up to heaven, another bird joined them.  
Then there were ...... seven (Show one hand and two fingers on the other)!  
Seven little birds think they are just great, one more came..........  
And now there are eight (Show one hand and three fingers on the other)
Eight little birds just as happy as can be, Eight little birds singing songs for you and me.

C) Questions to ask after story:

a. How many birds did we start with? <1>

b. How many flew in each time? <1>

c. Let’s say we had 4 birds and another bird flew in, how many would there be?
   i. If needed: The answer is just the number that comes right after 4! What number comes after 4?
   ii. If you don’t know, you can always count from 1 to figure it out. One more than 4 is 1, 2, 3, 4, <pause> 5! (say this even if children knew answer was 5)

d. Repeat c. with numbers 3, 5, 7 (as time/attention permits)

e. There was a rule in the numbers in our story just like patterns follow a rule. What was the rule for the numbers in our story? How did we know how many birds there were each time?
   i. The rule was that whenever we added one bird, the answer was always just the very next number.
VI. What’s Different? Add One (Small Numbers)

Materials Needed: Bug toys, felt piece

1. Let’s keep looking for patterns in numbers!
2. Take 2 of the same objects. How many <object name> do I have? Let children count the objects if needed.
3. I am going to hide them, and for this game, then I’m going to put in one more. Your job is to figure out how many I have!
   a. Cover objects with felt. Add one to the group
   b. Now there are more. Remember I added one more. How many are there now? Why do you think there will be <Child’s answer>?
      i. If need help coming up with an answer, say, let’s think about what number comes right after 2.
      ii. If more prompting is needed: We can use counting to figure out the next number. We need to figure out the number that comes after 2. Count with me (hold up fingers on right hand, and count them, not objects!), 1, 2 and then the number after is ...........3!
   c. <take felt away> That’s right/actually we started with two, show 2 fingers on right hand. I added one more, bring the left pointer finger over to the right 2 fingers. So the next number is 3, because when we count, 3 comes after 2! Repeat hand gestures.
4. Continue in the sequence up to 5 (3+1, 4+1, 5+1)
   a. If children have issues with the task, try not hiding the transformation (don’t use felt).
5. Reflect: There was a rule in the numbers. Numbers follow rules just like patterns follow rules. What was the rule for our game?
   i. <listen to responses> Right, the rule for the game is that whenever we add one more, the answer is always the number that comes next. So when I
Session 1

had 3 bugs and added 1, how many did I have? <4> Right, because 4 is the next number after 3.

VII) Walk back to class (teach Billy the little bird story and the rule for how you can tell “how many” when adding one more)
Session 2:
Pattern Duplication & Extension; 
+1 Rule with Cube Stairs

**Pattern Objectives:** To recognize, duplicate, and extend repeating patterns,

**Numeracy Objective:** To understand successor principle of +1 with small numbers

**Materials:** Horse Puppet, string/ribbon with pattern tags, beads, non-pattern bead necklace, unifix cubes, iPad
I. Billy in clip/clop pattern (AB)

Materials Needed: Horse Puppet

a. Experimenter: Hello children! Do you remember my very special friend Billy?

b. Billy: Hello, boys and girls, so nice to see you again today! Let’s take a trip to my home in the barn. Follow me!

c. Experimenter: Remember, when Billy walks, he goes clip clop, clip clop (while stomping each foot, emphasizing left, right, left, right stomp). Let’s walk like Billy on our way to the barn! (Walk to training room, clomp like horses.)

d. Great job making clip-clop noises while we walked here! His sounds make a pattern because it has a part that repeats.

e. What part repeats over and over? <clip-clop>
II. **Stringing Beads:**
Materials: Beads, strings with pattern tags on them

IIA. **Intro:** Remember, we are pattern detectives. And we are looking for **repeating patterns now** (make binoculars with hands and look around through them). **Repeating patterns** follow a rule that one part repeats over and over. To help us find the rule, we can say the pattern out loud. Once we know the rule, we know what comes next.

IIB. **Group AB**
Use string that is tagged with AB pattern tags and beads of two different colors

1. Experimenter creates pattern with beads, with children telling experimenter what beads to use. **This shows us the pattern to make** (point to pattern tag). **What color do we start with?** \(<>\) **Right, orange.** (add orange bead)
   a. And then what comes next? **Right, purple** (add purple bead)
   b. And now we repeat it. **What comes next?** (add orange and purple beads)
   c. And now we repeat it again. **What comes next?** (add orange and purple beads to create 3 full pattern units with beads)

2. **Can you describe the pattern?**

3. **Right, we have one orange, one purple** \(<\text{simultaneously point to the orange with right pointer finger and purple with left pointer finger, remove fingers, then repeat gesture}>\), **and one orange one purple, and one orange one purple**

4. **Let’s keep the pattern going. What comes next?**
   Answer: one orange-one purple. Add beads to string. Try to encourage kids to say 1 orange 1 purple rather than just orange purple.
a. If child is having trouble, say, **If you don’t know, you can say the pattern from the beginning to figure out what comes next.**

**II.C. Individual ABB with labeling**

1. **Now you try one!**
2. Give each child AAB pattern tag and corresponding beads. **This shows us the pattern to make. Please make this pattern.**  
   a. If needed, prompt children with **What comes next?** until make 3 repetitions of pattern’s core unit.
3. **Great! Let’s look at the pattern together. How many blue do we start with?** <1-hold up 1 finger on right hand> **Then how many Green?** <2-Hold up 2 fingers on left hand> **Then it repeats** (repeat gestures): 1 blue, 2 green. So the part that repeats in this pattern is 1-2. So we can call it a **1-2 pattern** (repeat gestures)!
4. **What can we call it?** <A 1-2 pattern> **Why?** <because we start with 1 <blue> and then 2 <green>.
5. **The rule for this pattern is that 1-2 repeats because 1 blue, 2 green repeats over and over again. So we can always know what comes next!**
IID. Individual AAB with labeling

1. Try another one! This shows us the pattern to make. Please make this pattern.
   a. If needed, prompt children with *What comes next?* until make 3 repetitions of pattern’s core unit.

2. Great! How many oranges do we start with? *<2>* Then how many yellow *<1>* Then it repeats: 2 orange, 1 yellow. So the part that repeats in this pattern is 2-1!
III. Reflect

Materials: Non-pattern Bead necklace
Material should be very obvious it is not a pattern (i.e. different colors and shapes of beads)

Does this necklace have a pattern? How do you know?
What do you think <child who didn’t answer>?

There is not a pattern. There is not a part that repeats over and over. It doesn’t have a rule that tells us what comes next.
IV. Dancing Patterns AAB

Materials Needed: iPad with music

Now we’ll make patterns while we dance!

a. Go Noodle Pattern Song (pilot to see if pattern 2 doesn’t work)
   i. For session 2, stop song after second pattern - “nod, clap, shake your hips”
      Turn it up
      Patterns in the air, patterns everywhere
      Patterns made of shapes, patterns made of grapes
      Patterns on a cheetah, patterns on my feet-ah
      Patterns in an app, patterns in this rap
      Make a pattern, make a pattern, let’s make a pattern, alright
      Make a pattern, make a pattern, let’s make a pattern
      Ok, here’s one.

Let’s do the first pattern together again. It goes “banana, banana, meatball”. (Do three times)

a. How many bananas do we start with? <put 2 fingers up on the right hand> And then how many meatballs? <put 1 pointer finger up on the left hand>. So we can call it a 2-1 pattern!

b. <Child 1>, why can we call it a 2-1 pattern? < >

c. It’s a 2-1 pattern, so the rule for this pattern is that 2-1 repeats over and over. <Child 2>, what is the rule for this pattern?
V. Numeracy: Build cube stairs 1-5

Materials: unifix cubes in 5 colors

A. Intro: We are always looking for rules. Remember, numbers follow rules just like patterns follow rules. When we find a pattern, we know what comes next. In numbers, we can use counting to figure out what comes next.

B. Warm-up: We are going to make stairs out of cubes, but first we’re going to practice counting to 5. 1-2-3-4-5!

C. Build Stairs. Now we will make stairs out of these cubes, starting at 1 and going up to 5.
   a. [Show them two steps using the cubes (one cube for the first step, two cubes for the second; use different colored cubes to build each step so child can easily count them]
   b. [Child X], How many cubes do we need to make the next step?” <3>
      a. If need help, say remember, we should always think about what number comes next. What number comes right after 3?
      b. If need extra prompting, say, you can use counting to figure it out if you need to. 1, 2,...<3>” pointing to each step as you count
   c. Right! We knew this because the number that comes right after 2 is 3. 3 is 1 more than 2, so it’s bigger!”
   d. Experimenter should build the next stair with the same number of cubes as the previous step and say: Ok, I have 2 cubes but we need 3.

What do we need to do?
   a. “Right, add one more! The last step had 2 and we added one more, so now this step has <3>.
   e. Repeat until build step 5. Alternate calling on each child.
   f. When stairs are complete, say: Look! See the rule! In stairs, each step has one more cube than the one before. Just like when we count, the next number is one more than the one before (point to top cube of each stair).
   g. Compare steps by picking out two adjacent steps:
      a. Remember, the next step is always one more than the one before it, so the 5 step is one more than the 4 step
      b. “X, How much bigger is the 2 step than the 1 step?” <1 cube>
1. That’s right/actually 2 is 1 more than 1. Remove the top cube and compare steps, then re-add cube.
   c. “Y, How much bigger is the 3 step than the 2 step?”
      1. Right/actually 3 is 1 more than 2. Remove the top cube and compare steps, then re-add and re-compare.
   d. Continue as is helpful, try to skip around

D. Bridge to Counting.
1. This tells us something very important about counting. These steps go 1-2-3-4-5. <point to steps as you go> The next number you say when you count is one more.
2. <Child 1>, What do you get when you add one more to 3?”
   <maybe know it’s 4> The answer is the very next number after 3!
   What number comes after 3?
      a. If needed: If you don’t know, you can just count 1 - 2 – 3- ?<pausing>
      b. If correct: Right, 4! 4 comes after 3, so it’s one more than 3!
         So what’s one more than 3? <4>. Yes, 4. The next number you say is one more. That also makes it bigger!
3. <Child 2>, What do you get when you add one more to 2?
   <3>The answer is the very next number after 2. What number comes after 2?
      a. If needed: If you don’t know, you can just count 1-2-?”
      b. If correct: Yes, 3. 3 comes after 2, so it’s one more than 2!
         The next number you say is one more. That also makes it bigger!
4. <Child 1>, What do you get when you add one more to 4? <5>.
   The answer is the very next number after 4. What number comes after 4?
      a. If needed: If you don’t know, you can just count “1-2-3-?”
      b. If correct: Yes, 5. 5 comes after 4, so it’s one more than 4!
5. Repeat as productive. Try skipping around.
VI. Walk back to class: Ask children to tell Billy one thing that they learned today
Session 3:
Identifying the Core Unit; -1 Rule

**Pattern Objectives:**
To recognize, duplicate, and extend repeating patterns,
To recognize the core unit of repeating patterns

**Numeracy Objective:**
To recognize the successor principle in subtraction of small numbers

**Materials:** horse puppet, iPad; connecting cubes in 4 colors, 10 of each color; AB shape pattern strip; shape pattern strip booklet, pipe cleaners, pattern blocks, plastic bag with various bugs and felt

**Vocabulary:** A core unit is the part that repeats
I. Walking to room with Billy

Materials Needed: Horse Puppet

Experimenter: Hello children! Do you remember my very special friend Billy?

a. Billy: Hello, boys and girls, so nice to see you again today! Let’s take a trip to my home in the barn. Follow me!

b. Billy: How old are you?
   i. X, how old will you be next year? *answer* And how old were you last year? *answer*
   ii. Y, how old will you be next year? *answer* And how old were you last year? *answer*
   iii. Right, you are <5> now, and will be <6> next year! I am 6 years old. How old will I be next year?
      1. IF NEEDED: We can count to figure it out!
         1-2-3-4-5-6-?
II. Core Unit with Unifix Cubes (AAB)

Materials: Unifix cubes in 4 colors, 10 each color

IIA. Intro: Remember, we are pattern detectives. First, we will look for repeating patterns (make binoculars with hands and look around through them). Repeating patterns follow a rule that one part repeats over and over. To help us find the rule we can say the pattern out loud. Once we know the rule, we know what comes next.

IIB. Create AAB core unit
a. Make a strip of 3 cubes in AAB Pattern (like yellow-yellow-orange)

b. In repeating patterns, the part that repeats over and over again is called the core unit. Let’s say that together “core unit.” This is our core unit: Yellow-Yellow-orange. Point to the 2 reds with 2 fingers on the right hand and to the 1 blue with the left pointer finger.

c. Can you each make the same core unit as me?

d. After children make their core unit, Let’s put all of our core units together.

e. Look, now we have a pattern! It goes 2 <yellows>, 1 <orange> and 2 <yellows>, 1 <orange>… Chant color names as you point to each cube in the pattern, using same gestures as above

f. What is the core unit for this pattern? <yellow-yellow-orange, or “two yellow, 1 orange”, or 2-1> Right, that’s the core unit! It has 2 yellows, 1 orange, so it uses a 2-1 pattern. Use same gestures as above

g. We know the pattern, so we know what comes next! What comes next? <yellow-yellow-orange>

IIC. Repeat above with new colors for AAB pattern (keeping first stack assembled)

IID. Link Look, these two patterns use different colors, but they both have the same core units. For each, the pattern’s core unit is two that are the same, one that is different. They both have a 2-1 core unit.
And since they are repeating patterns, they both have the rule that the 2-1 core unit repeats over and over.
IV. Pattern Strips (The Core Unit)

Materials: 1 AB shape pattern strip, line pattern strip booklets, pipe cleaners

IV-A. Intro. Ready for some more patterns!
Let’s sing our pattern song together.
Oh dear, what can the pattern be? (x3) Let’s look at the pattern and see.

Remember, in repeating patterns, the rule is that there’s always one part that repeats over and over again, that is called the core unit.

IV-C. Pattern Booklet with Straws (ABB, AABB)

a. Let’s try one in your pattern book. (ABB pattern - pg. 7 in pattern strip booklet) What is the core unit for this pattern?
   a. If needed (e.g., they name all items): Remember, the core unit is just the part that repeats over and over again. So, it’s just red-green-green <gesturing with 2 fingers on right hand and 1 on left hand>. We can also say 1 is different, 2 that are the same.
   b. It has a 1-2 pattern!

b. Please copy the pattern here. Start with the core unit. <it’s ok if kids just copy entire pattern without stopping at core unit>

c. Because it’s a pattern, we know what comes next! Please show me what comes next.
   i. If needed. Remember, the core unit in this pattern is red-green-green or 1 that is different 2 that are the same.

d. Let’s do the next one in your pattern book (AABB pattern - pg. 8 in pattern strip booklet). What is the core unit for this pattern?
Repeat a-c
III. Dancing Patterns: Go Noodle

Materials Needed: iPad with Go Noodle Video

Now we’ll make new patterns while we dance again!

Go Noodle Pattern Song - For session 3, stop song after 1st pattern (can go longer if time allows)

Turn it up
Patterns in the air, patterns everywhere
Patterns made of shapes, patterns made of grapes
Patterns on a cheetah, patterns on my feet-ah
Patterns in an app, patterns in this rap
Make a pattern, make a pattern, let’s make a pattern, alright
Make a pattern, make a pattern, let’s make a pattern
Ok, here’s one.

Let’s do the first pattern together again. It goes “banana, banana, meatball”. (Do three times)

a. What is the pattern’s core unit?
   i. If needed: How many bananas do we start with? <2>
      Hold up 2 fingers on right hand And then how many meatballs? <1> Hold up 1 finger on the left hand.

b. So the pattern’s core unit is 2-1! Simultaneously hold up both sets of fingers.

c. Just like our cubes are a 2-1 pattern!
V. Reflect

How did you figure out a pattern’s core unit?

a. Children might say: I just look to see which part of the whole pattern goes on

b. To figure out a pattern’s core unit, you look for the part that repeats over and over again.
VI. Numeracy:
5 Little Monkeys Jumping on the Bed (Subtracting one)

Materials: None!

VI-A. Intro. We can look for rules in numbers too! Numbers follow rules, just like repeating patterns. Once we know the rule, we know what comes next.

VI-B. Warm-up. We’re going to sing a song called 5 little monkeys, but first we’re going to practice counting backwards from 5. (count on your hands from 5. Have kids count with you but they don’t need to use their fingers) 5, 4, 3, 2, 1, BLAST OFF!

VI-C. Song intro. Now, everyone open one hand like this (show them your open hand with palm facing up) Now the fingers on our other hand are going to be our monkeys (show the fingers of other hand jumping on the “bed” of the first hand). As each monkey falls off the bed, we can put a finger down.

VI-D. Words and additional actions:
1. Five little monkeys jumping on the bed (use fingers and palm to demonstrate as explained above), one fell off and bumped his head (lightly tap head)
2. We called for the doctor and the doctor said (pretend to hold phone to ear)
3. No more monkeys jumping on the bed (shake index finger in a “that’s a no-no” way)
4. Now how many monkeys are jumping on the bed? <4> Right!
5. Four little monkeys jumping on the bed... Repeat above
6. For one monkey say: One little monkey jumping on the bed, he fell off and bumped his head (lightly tap head)
   a. We called for the doctor and the doctor said (hold pretend phone to ear)
   b. (Loudly) that’s what you get for jumping on the bed! (shake index finger in a “that’s a no-no” way)

VI-E. Follow-up Questions
1. How many monkeys did we start with? <5>
2. How many fell off the bed each time? <1>
3. So we had 5 and then one fell off so we had how many monkeys? 4
   a. Then another fell off so we had? <3>
4. Let’s say we had 4 monkeys on the bed and then one fell off, how many would there be?
   a. If needed: The answer is just the number that comes right before 4! What number comes right before 4?
   b. If you don’t know, you can always count backwards from 5 to figure it out. The number before 4 is 5, 4, <pause> 3! (say this even if children knew answer was 3)
   c. Repeat with numbers 3, 2,
5. There was a rule in the numbers in our game just like patterns follow a rule. What was the rule for the numbers in our game? How did we know how many monkeys were left? <One monkey fell off each time>
   a. Right, the rule for our game was that when one monkey fell off, the answer was always the number that comes right before. So when we had 3 monkeys and one fell off, how many monkeys did we have left? <2> Right, because 2 comes right before 3.
VII. What’s Different? Subtracting one with small numbers

Materials: Bug toys, felt piece

VII-A. Intro: Let’s look for some more rules for numbers! Once we know the rule, we know what comes next. If we don’t know what comes next, we can use counting to figure it out.

1. Take Five of the same color objects. Put them in front of the children and ask: how many <object name> do I have? Let children count the objects if needed.

2. I am going to hide them, and for this game, I’m going to take one away. Your job is to figure out how many I have now!

3. Cover with felt and take one object from the group (show it to the children) and ask: Now there are less objects. Remember, there were 5 and I took away 1! How many are left? <four>. Why do you think there will be <Child’s answer>?
   a. If need help, first say let’s think about what number comes right before 5
   b. If need more help, say, to figure out what number comes right before 5, we can count backwards! Start at 5 and count backwards with children 5, 4! (show on your fingers)
   c. We started with five. I took away one. Now there are four.

4. Continue trials in a sequence down from five (4-1, 3-1, 2-1)
   a. Repeat 5-1 and 3-1 if they are up for it

5. Reflect: There was a rule in the numbers. Numbers follow a rule just like patterns follow a rule. What was the rule for our game? How did we know how many bugs were left each time?
   a. <listen to responses> Right, whenever we take one away, what’s left is always the number that comes right before it when we’re counting! So when we had 2 and I took away 1, how many were left? <1> Right! Because 1 comes right before 2.
VIII. Walk back to class: Review the 5 Little Monkeys Song for Billy and what happens when you take 1 away.
Session 4:
Abstract Patterns and Successor Principle with Large Numbers

Pattern Objectives:
   Extend and Abstract Patterns
   To recognize the core unit of repeating patterns

Numeracy Objective:
   To understand the successor principle with larger numbers (6-10)

Materials: horse puppet, iPad, pattern strips, unifix blocks, pompoms, foam cubes, shape pattern strip booklet
I. Walking to room with Billy (in flick-flick-swoosh pattern)

Materials Needed: Horse Puppet

a. Experimenter: Hello children! Do you remember my very special friend Billy?
b. Billy: Hello, boys and girls, so nice to see you again today! Let’s take a trip to my home in the barn.
c. Remember, when Billy walks, he goes clip clop, clip clop with his feet? He also makes other noises with his tail. He goes Flick Flick (making flicking movements with all fingers on free hand), Swoosh (sweep both hands to the left (Walk to training room, making these motions.) Let’s walk to the barn with Billy!
d. Great job making flick flick swoosh noises while we walked here! His sounds make a pattern because it has a part that repeats.
e. What is the core unit, or the part repeats over and over? <flick flick swoosh>
II. Abstract Patterns with Pattern Strips

Materials: 6 pattern strips with glued on shapes, foam cubes, pompoms, shape pattern strip booklet;

IIA. Intro: Remember, we are pattern detectives. In math, we should always look for patterns. Now, we will look for repeating patterns. 

Sing: 
Oh dear, what can the pattern be? (x3)
Let’s look at the pattern and see

IIB. EXAMPLE 1 – Given AB

[Place pattern A1 (green triangle, tan diamond) in front of the child.]

a. Repeating patterns follow a rule and the rule is that the core unit repeats. Let’s find the core unit for my pattern. The part that repeats in my pattern is one – a different one

b. Let’s point while we say the core unit together: one [point w/ right pointer finger] – a different one [point w/ left pointer finger]. THEN it starts over again, one – a different one (slowly uncover 2nd unit & point); <Pause> and again, one – a different one

i. <If a child doesn’t say it aloud with you, stop and say, “Can you say it with me?” and start over>

c. [Place pattern A2 with blue and green cubes 4 inches below A1].
Now, let’s find the core unit for your pattern (sweep finger across A2).

d. Look, the part that repeats in your pattern is also one – a different one

e. Let’s point while we say the core unit together: one (point w/ R pointer finger) – a different one (point left pointer finger). And the core unit repeats and repeats again

f. These patterns are alike because the core unit for both is: one, a different one. Or we can call it a 1-1 pattern lift up pointer fingers on both hands simultaneously.
g. **The core unit is:** one (point to A in both patterns using right pointer finger) – a **different one** (point to B in both patterns using the left pointer finger). **Let’s say the core unit together:** one – a different one.

h. **These patterns are alike because they both have the rule that one- a different one repeats over and over.**
IIC. EXAMPLE 2 – Make AB

a. Now it’s your turn to make a pattern!

b. (Give pattern booklet (pg. 9) with AB shape pattern strip. Place red and purple pom-poms in a container to the right of each child).

Here is a pattern (gesture). Please each make the same kind of pattern here, using some of these pom-poms.

c. Make sure you leave your pattern out so we can talk about it when you’re done.

i. For each child:

   1. IF CORRECT: “Good job! That pattern is the same kind of pattern as mine.”
   2. IF INCORRECT: “Here is what I would do to make it the same kind of pattern as mine.” (fix pattern)

d. Remember, two repeating patterns are alike if they have the same core unit. To find the core unit, we look for the part that repeats. The part that repeats in this pattern is one – a different one (cover up 2nd and 3rd units; point to A and then B with both pointer fingers). Let’s point while we say the core unit together: one (point) – a different one (Point). (Pause)

THEN, it repeats here (slowly uncover 2nd unit & point), and here (slowly uncover 3rd & point).

e. Look, the part that repeats in your patterns is also one – a different one. Let’s look at <child x>‘s. [Child X], point and say the part that repeats. <one – a different one, 1-1, ok if names colors>.

i. If needed (e.g., they name every item): Remember, the core unit is just the part that repeats. So, it’s just one - a different one. (pointing simultaneously with 2 different pointer fingers)

f. These are all the same kind of patterns because the part that repeats, or the core unit, is the same: one – a different one (lift up pointer fingers on both hands simultaneously). Let’s say the core unit together: one – a different one (lift up pointer fingers on both hands simultaneously again).
IIE. EXAMPLE 3 – Make ABB

a. Turn to next page (pg. 10) in pattern booklet (gesture to model pattern) Please each make the same kind of pattern here.
   i. Feedback to each:
      1. IF CORRECT: Good job! That pattern is the same kind of pattern as mine.
      2. IF INCORRECT: Here is what I would do to make it the same kind of pattern as mine. (fix pattern)

b. Remember, two repeating patterns are alike if they have the same core unit. Let’s find the core unit for the given pattern (sweep finger across one child’s booklet). What is the core unit for this pattern?
   i. IF CORRECT: Right.
   ii. IF INCORRECT: Actually, the part that repeats is two that are the same, one that is different (cover 2nd unit with paper & point appropriately to 1st unit)

c. Look, the part that repeats in your pattern is also two that are the same, one that is different. Let’s look at [child y]’s. [Child Y], point and say the part that repeats.
   i. If needed (e.g., they name every item): Remember, the core unit is just the part that repeats. So, it’s just one that’s different, two that are the same. (pointing simultaneously)

d. These are the same kind of patterns because the part that repeats, or the core unit, in both is: two that are the same, one that’s different. (use fingers on each hand to gesture, as noted). Let’s say it together: two that are the same, one that’s different. (use fingers on each hand to gesture, as noted).

e. What else could we call this pattern? <1-2 pattern>
II-G. EXAMPLE 4 – Make AABB  

a. (Turn to next page (pg. 10) in pattern booklet. Each child should get different colored materials for this trial)  

b. Here is a pattern. (gesture to model pattern) Please each make the same kind of pattern here.  

i. Feedback:  
   1. IF CORRECT: Good job! That pattern is the same kind of pattern as mine.  
   2. IF INCORRECT: Here is what I would do to make it the same kind of pattern as mine. (fix pattern)  

c. Now, [Child X], tell me how your pattern (sweep finger) is like this one. (sweep finger)  

i. If child does not respond to third prompt, rephrase prompt: It’s ok if you aren’t sure. Can you think of a way that your pattern is like my pattern?  
   1. If child simply says, “It’s the same,” with no information on how it is the same, ask: How are they the same? <and accept whatever they say>  

d. Now, [Child Y], tell me how your pattern (sweep finger) is like this one. (sweep finger)  

1. Same prompts as for Child X.  

e. One important way the patterns are alike is they both go 2 that are the same, two that are different (use thumb/forefinger gesture in 1st units to link both patterns). Let’s say the core unit together: 2 that are the same, 2 that are different, (repeat point 1st units). And THEN, the rule is that it starts over again, 2 that are the same, 2 that are different (slowly uncover 2nd units & point). We can call them 2-2 patterns (lift fingers up to show a 1 on the right hand and 2 on the left)  

f. These patterns are alike because they have the same rule that 2-2 repeats over and over.
IV. Reflect

What does it mean to make the same kind of pattern even if they look different?
   a. Child may provide an answer
   b. Patterns can be the same even if they look or sound different, as long as they have the same core unit
III. Dancing Patterns: Go Noodle Video
Now we’ll make new patterns while we dance again!

Go Noodle Pattern Song - For session 4, stop at 2:40
Turn it up
Patterns in the air, patterns everywhere
Patterns made of shapes, patterns made of grapes
Patterns on a cheetah, patterns on my feet-ah
Patterns in an app, patterns in this rap
Make a pattern, make a pattern, let’s make a pattern, alright
Make a pattern, make a pattern, let’s make a pattern
Ok, here’s one.

Let’s do the first pattern together again. It goes “banana, banana, meatball”. (Do three times)

a. How many bananas do we start with? <2> And then how many meatballs? <1>. So the core unit is 2-1, and our pattern rule is that 2-1 repeats over and over!
V. Numeracy Cube stairs 6-10 (first review 1-5)
Materials: Steps 1-5 pre-assembled (use different colored cubes within each step so child can easily count each cube) + bag of unifix cubes

A. Intro. We are going to keep being detectives and look for the rules in numbers just like we look for rules in patterns! Remember, patterns follow a rule. When we find a pattern, we know what comes next. We can do the same thing with numbers, if we don’t know what comes next, we can always use counting to figure it out.

B. Review stairs 1 to 5. Remember how we built our cube stairs last time? Show preassembled steps 1-5 and walk your fingers up the steps. Count with me as I walk up the steps (use fingers). 1, 2, 3, 4, 5. See the pattern! In stairs, each step has one more cube than the one before, and we can use counting to tell what’s next.

C. Build Cube Stairs 6-10
   a. We are going to continue making stairs out of these cubes but first we’re going to practice counting to 10. 1-2-3-4-5-6-7-8-9-10!
   b. How many cubes are on this stair? <five>
   c. <Child X>, How many cubes do we need to make the next step? <6>
      a. If need help, say remember, we should always think about what number comes next. What number comes right after 5?
      b. If need extra prompting, say, you can use counting to figure it out if you need to. 1, 2, 3, 4, 5,...” pointing to each step as you count
   d. Right! We knew this because the number that comes right after 5 is 6. 6 is 1 more than 5.
   e. Experimenter should build the next stair with the same number of cubes as the previous step and say: Ok, I have 5 cubes but we need 6. What do we need to do?
      a. “Right, add one more! The last step had 5 and we added one more, so now this step has <6>.
   f. Repeat until build step 10. Alternate calling on each child.
   g. When stairs are complete, say: Look! See the rule! In stairs, each step has one more cube than the one before. Just like when we count, the next number is one more than the one before (point to top cube of each stair).
h. Compare steps by picking out two adjacent steps:
   a. Remember, the next step is always one bigger than the one before it, so the 5 step is one more than the 4 step
   b. “X, How much bigger is the 6 step than the 5 step? <1 cube>
      i. If student points to the top cube, say that's right/actually, 1 cube! 6 is one more than 5. Remove the top cube and compare steps, then re-add cube.
   c. “Y, How much bigger is the 7 step than the 6 step?” <1 cube>
      i. Right/actually 7 is 1 more than 6. Remove the top cube and compare steps, then re-add and re-compare.
   d. Continue for 8, 9 and 10.

D. Bridge to Counting

1. This tells us something very important about counting. These steps go 1-2-3-4-5-6-7-8-9-10. <point to steps as you go> The next number you say when you count is one more.
2. <Child 1>, What do you get when you add one more to 6?” <maybe know it’s 7> The answer is the very next number after 6.
   a. If needed: If you don’t know, you can just count 1 - 2 - 3 - 4 - 5 - 6 - ? <pausing>
   b. If correct: Right, 7! 7 comes after 6, so it’s one more than 6! So what’s one more than 6? <7>. Yes, 7. The next number you say is one more.
3. <Child 2>, What do you get when you add one more to 7? <maybe know it’s 8>. The answer is the very next number after 7. What number comes right after 7?
   a. If needed. If you don’t know, you can just count 1 - 2 - 3 - 4 - 5 - 6 - 7 - ?
   b. If correct: Right, 8. 8 comes after 7, so it’s one more than 7! So what’s one more than 7? <8>. Yes, 8. The next number you say is one more. That also makes it bigger!
4. <Child 1>, what do you get when you one more to 8? <same help>
5. Repeat as productive
VI. Walking back to class: Have Billy name a number between 1-10 and ask the children one at a time to tell you what number comes next as quickly as possible
Session 5:
Review Abstract and Core Unit; Generalize Successor Principle

Pattern Objectives:
- To abstract and extend repeating patterns,
- To recognize the core unit of repeating patterns

Numeracy Objective:
- To review and generalize the successor principle across small and large numbers, adding and subtracting 1.

Materials: Billy the horse, iPad, unifix cubes, felt and bugs, foam cubes, non-transparent bag/box
I. Walking to room with Billy (sing 5 little monkeys rhyme)

Materials Needed: Horse Puppet

Experimenter: Hello children! Do you remember my very special friend Billy?

a. Billy: Hello, boys and girls, so nice to see you again today! Let’s take a trip to my home in the barn. Follow me!

Billy: The other day I heard you singing a silly song about monkeys, do you think you can teach it to me? How did it start?

Billy: Thanks for teaching me that song! How many monkey’s fell off the bed each time? <1> You’re right one monkey fell off each time so we started with 5 and then we had 4 and then…. <let kids answer—go all the way to no monkeys>. That’s right, one monkey fell off each time until there were no more monkeys!
II. Cube Patterns - Core Unit

Materials: Unifix cubes in 4 colors, 10 each color

Remember, we are pattern detectives. First, we will look for repeating patterns. Repeating patterns follow a rule that the core unit repeats over and over. When we say the pattern out loud, we can know what comes next. In math, we should always look for patterns.

IIA. Make a stack of 4 cubes (AABB Pattern)

1. In repeating patterns, the part that repeats over and over again is called the core unit. This is our core unit: <make a 2-2 pattern>
2. Can you each make the same core unit as me?
3. Let’s put all of our core units together. Now we have a pattern! It goes... Chant color names as you point to each cube, with 2 fingers in each hand pointing to the pattern unit
4. What is the core unit for this pattern? <2 that are the same and another 2 that are the same>
   a. Right, it’s the core unit! It starts with 2 that are the same, 2 that are different, so it has a 2-2 core unit. <with 2 fingers in each hand pointing to the pattern unit>
5. We know the pattern, so we know what comes next! <Child x>, what comes next? If you don’t know, you can say the pattern out loud to figure out what comes next. <make full unit>
IIB. Make a different stack of 4 cubes (AABB Pattern)

1. Let’s make a new pattern with a 2-2 core unit.
2. X, what color should we start with? And how many do we need?
3. Y, what color should we use next? How many do we need?
4. Great, that’s our core unit. Let’s each make a core unit of 2 that are the same, 2 that are different.
5. Let’s put all of our core units together. Now we have a pattern! 
   It goes… Chant color names as you point to each cube, with 4 fingers extended to point to a pattern unit
6. We know the pattern, so we know what comes next! <Child Y>, what comes next? <add full core unit>

7. These two patterns use different colors, but they both have the same core unit. What is the core unit for both patterns? <>
   Right/Actually, for each, the pattern core unit is two that are the same, two that are different. They both have a 2-2 core unit.
III. Dancing Patterns: Go Noodle Video

Materials Needed: iPad with music

Now we’ll make new patterns while we dance again!
Start right after 2nd pattern so they hear the rap before the 3rd pattern (end after loud-loud-quiet-quiet pattern)

1. Let’s do the pattern together again. It goes “loud, loud, quiet, quiet”. (Do three times, with movements)
   a. How many louds do we start with? <2> And then how many quiets? <2>. So the pattern’s core unit is 2-2!
   b. What is the pattern core unit? <wait for response>

2. Let’s make a new pattern with a 2-2 core unit!
   Maybe we could clap and stomp.
   a. How many times do we need to clap? <2> then how many times do we stomp? <2>
   b. Great, let’s do it!

2. How are our dance patterns like our cube patterns? <They all have a 2-2 core unit!>
III. Numeracy: Unit Task
Materials Needed: Non-transparent cup, 6 sets (4 green cubes, 5 yellow cubes, 7 blue cubes, 9)

1. 3+1—Green Cubes
   a. Begin by placing 3 cubes in the cup, OK, I’m putting three cubes in here. Ask: How many cubes are in the cup right now?
   b. If answer is incorrect, Oops, let’s try again, and repeat the beginning of the trial. Continue until correct.
   c. If answer is correct, Right! Now watch…”(Make sure the child is looking)
   d. Add one more cube to the cup and ask: How many do I have now?
      1. If no response: Remember, we should always think about what number comes next. There were 3 cubes and we added one, so let’s think about what number comes right after three?
      2. If answer is incorrect or no response: We can use counting to figure out what number comes after 3. Let’s start at one and count together. 1, 2, 3, and next comes (allow child time to respond) four! Let’s try another one.
3. If answer is correct: **Great job, that’s right!** I started with three cubes, and I added one more cube, so now I have four cubes, we knew this because 4 comes right after 3 when we count! Let’s try another one.

2. **Repeat with 4+1, 6+1 and 8+1**

**Reflection:**
Let’s think about the rule. Remember, numbers have rules just like patterns have rules. Our rule was that whenever we added one cube, the answer was always the very next number! So when I had 6 cubes and added 1, how many were there? <7> Yes, 7! Because 7 comes right after 6.
VI. What’s different? Integrate previous lessons
Let’s keep looking for patterns in numbers! Now we’re going to play our hiding game again.

VI-A: Adding 1: (2+1, 5+1, 7+1)
   a. (2+1). Take 2 of the same objects. How many bugs? do I have?
      Let children count the objects if needed.
   b. I am going to hide them, and for this game, I’m going to put in one more. Your job is to figure out how many I have!
      i. Cover objects with felt. Add one to the group under the felt.
      ii. Now there are more. Remember I added one more. How many are there now? <3>. Why do you think there will be <child’s answer>?
         1. If need help: let’s think about what number comes right after 2.
         2. If more prompting is needed: We can use counting to figure it out. We need to figure out the number that comes after 2. Count with me (hold up fingers on right hand, and count them, not objects!), 1, 2 and then the next number is……….3!
      iii. <take felt away> That’s right/actually we started with two, I added one more, so the next number is 3, because when we count, 3 comes after 2!
      iv. Repeat this task with numbers 5->6 and 7->8
   2. VI-3: Reflect: There was a rule in the numbers. Numbers follow a rule just like patterns follow a rule. What was the rule?
      a. <listen to responses> Right, the rule was when you add one, the answer is always the very next number.
         1. Example: So when I had 4 bugs and I added one more, how many did I have? <5>. Right, because 5 is the next number after 4.

VI-B: Subtracting 1 (5-1, 3-1, 4-1)
a. We are going to try a different rule now. I am going to hide them, and this time, I’m going to take one away. Your job is to figure out how many I have now!

b. (5-1) Take Five of the same color objects. Put them in front of the children and ask: how many <object name> do I have? Let children count the objects if needed.

c. I am going to hide them, and I’m going to take one away. Your job is to figure out how many I have now!

d. Cover with felt and take one object from the group (show it to the children) and ask: Now there are less objects. Remember, there were 5 and I took away 1! How many are left? <four> Why do you think there will be <Child’s answer>?
   1. If need help: let’s think about what number comes right before 5.
   2. If more prompting needed: To figure out what number comes right before 5, we can count backwards! Start at 5 and count backwards (on fingers) with children. 5 (put one finger down), …. 4! There are 4.

e. We started with five, I took one away. Now there are four.

f. Repeat with 3->2, 4->3

VI-3: Reflect: There was a rule in the numbers. Numbers follow a rule just like patterns follow a rule. What was our rule for this part of the game?

i. <listen to responses> Right, the rule was when you take away one, the answer is always the number that comes right before. And we can always count backwards to figure out what comes before if we need to.
   1. Subtraction example: So when I had 4 bugs and I took one away, how many did I have left? <3>. Right, because 3 is the number right before 4.
VII. Say goodbye

You have done such a great job working with me! You have been great pattern detectives! Remember, we can find patterns all around us. There are patterns in objects, in sounds and in numbers! Be sure to be on the lookout for patterns. You are all done playing games with me and Billy.