



GAME OVERVIEW

In *Jumping on the Lily Pads*, children practice recognizing written numerals, using one-to-one correspondence when counting (and jumping), comparing numbers, subitizing, cardinality, and counting on. As they play, they can grow in their understanding of number magnitude and develop a mental number line they can visualize. The child tosses a number cube (with only 1 and 2 dots to start) and moves a frog game piece that number of “jumps” along the lily pads, which have the numbers 1 to 10 written on them. Then the other player jumps her frog. There are many variations of this game starting with a 1 to 5 board and extending to a larger board and more complicated rules in players move forwards and backwards to land exactly on 5 to eat a snack of 5 flies, then exactly on 10 to eat a lunch of 10 flies.

ABOUT THE MATH

If you watch and listen to how students interact with the games, you can learn a lot about what they know and what they’re ready to learn. Once you see what they can do, you can help them take the next step. In this game, children practice:

- Number magnitude and understanding that numbers come *before* or *after* other numbers
- Recognizing written numerals 1-5 (and possibly up to 10 or 20)
- Reciting number words in the correct order
- Using one-to-one correspondence when counting
- Identifying the number of dots without counting (subitizing)
- Composing and decomposing numbers

This section discusses some of the mathematical skills that children are building as they play. In mathematics, just as in their language and social/emotional skills, preschool children vary greatly in what they know and are able to do depending on their development and the experiences they’ve had. The more that mathematical ideas and play and talk becomes a regular part of their environment, the more they will learn.

Number magnitude. Experience moving physically along numbers sequenced in a line helps children develop a ‘mental number line’—a spatial representation of quantity that helps them reason about which is more and how much more. Children learn that 7 is more than 5 because 7 comes later in the counting sequence and on the number line. Later, they can determine how much more 7 is than 5, either by picturing its “distance” from 5 on the number line, or by knowing that 5 is contained within 7 (a part of 7) and the “other part,” the leftover, is 2. Studies have found that lower-income children can be significantly behind their middle-income peers in their knowledge of counting, comparing numbers, and their development of a mental number line (Jordan, Kaplan, Olah, & Locuniak, 2006; Starkey, Klein, & Wakeley, 2004). Some research has explored whether this could be the result of less experience playing board games

This work has been supported by funding from the National Science Foundation and Heising-Simons Foundation.

Citation: Reed, K. E., & Young, J. M. (2017). *Games for Young Mathematicians: About Jumping on the Lily Pad Games*. Waltham, MA: Education Development Center, Inc. <http://ym.edc.org/>

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that involve movement from space to space in a number-line-like way; other researchers have explored whether the differences result from less experience with conversations involving number, discussing how many, or how many more or less?

People tend to exaggerate the distances between smaller numbers—1, 2, 3, 4—and underestimate differences between larger ones. Think about how “far apart” a hundred and a thousand are. Are a thousand and a million similarly spaced? A million and a billion? This is built into us as human beings as a practical way of understanding difference. The difference between 1 and 2 is likely more practically significant (to us) than between, say, 96 and 98. In a collection as large as 98, you’d hardly miss 2 if you lost them but losing 1 of 2 things is losing a lot! There’s a huge difference between a 7-year-old and her 4-year-old sister, but by the time they’re 57 and 54, they’re “the same age.” Addition and subtraction require thinking about the precision as well. Helping children understand relationships between numbers on the number line is valuable for later mathematical reasoning and arithmetic. In preschool, children are working with small quantities and later that understanding will extend to large numbers.

In *Jumping on the Lily Pads*, children gain experience moving from space-to-space on the lily pad number path. Each time they jump on the lily pads one by one, they are reinforcing kinesthetically that each successive number is bigger by one. It also helps them to understand that the distance between consecutive whole numbers is the same—10 is one bigger than 9, just as 2 is one bigger than 1. The numbers on board are set up vertically, like a bar graph. Having to reach farther helps children notice that as they move from 1 to 5, or 1 to 10, they are moving farther from the start (home), and help them notice that, for example, 8 is farther away from home than 2. At this age, children are developing their understanding of number magnitude—learning that 5 is greater than 2, and beginning to get a sense of *how much* greater.

Cardinality. *Jumping on the Lily Pads* targets a different aspect of cardinality than some of the other games. Most of the other games target knowing how many in a collection or set of objects and gives them practices in naming how many in all. In this game, children are practicing counting out to a stopping number. In this case, they are counting the number of jumps (1, 2, or 3)—in other contexts they may be counting out objects such as crackers, plates, or toys. In the game, children roll a dot cube and subitize or count to know how many spaces to move. Children have to hold that number in their head (working memory) and then jump that number of spaces and stop jumping when they reach that number. For example, if a child rolls , they say three and hold that number in their head. Then they have to jump three times and know once they do they have finished counting—that three is how many in all. This is a complex set of skills to integrate and it may take many attempts before children are smooth at the whole process.

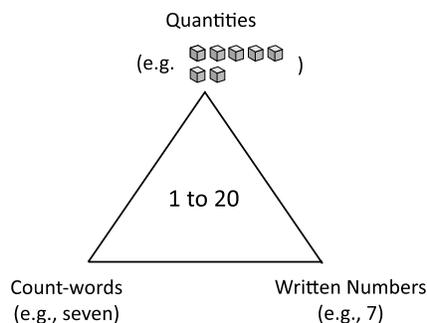
Recognizing written numerals 1-5 (possibly up to 10 or 20). Learning to recognize the written numerals is similar to learning to recognize the letters of the alphabet. For letters, they connect the written symbol to the letter name and the sound. For numerals, they connect the written symbol to the number name and the quantity it represents. The figure below shows

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this relationship. Some children may be ready to start writing numerals themselves just as they are writing some of the letters of their name. You may want to start them by writing the numeral for their age.

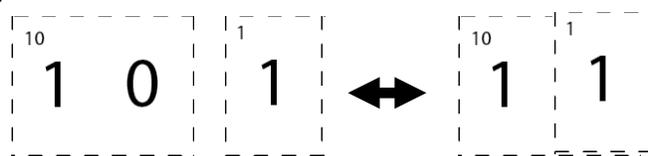
Pointing to and referring to the written numerals on the lily pads as you say the number name reinforces the link between the symbol and its name. The game board for *Jumping on the Lily Pads* is designed to give children practice recognizing the written numerals and learning what order the numbers appear. You can ask children which number they started from and which number they landed on.



Talking about 2-digit numbers (i.e. "What does the "1" in the number 12 mean?").

When we talk to children about two-digit numbers, we need to be careful about the language that we use. The 1 in 12 stands for 10; the written number 12 stands for 10 + 2. When talking to young children about two-digit numbers, we can say: "12, 10 and 2 make 12. The 1 in 12 stands for 10". Sometimes we might say: "1 and 2 make 12." When we are talking about writing 12, then yes, the digits 1 and 2 next to each other are 12. But if we are talking mathematically, 1 and 2 doesn't make 12, it makes 3. The language is not precise so it can be confusing for young children. You may want to use your fingers to show them how 1 plus 2 is 3 and compare that to how 10 and 2 make 12 (with your fingers). Or you can take 12 objects and group them into 10 and 2.

Preschool is not the time for children to formally learn about place value. In preschool, we just want to give children experiences with putting together and taking apart small numbers. When children are in first grade, these preschool experiences will help them learn that a group of tens ones can be grouped and counted as a single unit (one ten). In first grade, they learn that ten ones can be grouped and counted as a single unit (one ten). They may also see layered place value cards such as the ones below. But this formal instruction is for first grade, not for preschool.



Composing and decomposing numbers. Knowing that groups of objects can be combined and separated is part of children's everyday world. For example, if there are 4 glue sticks at the art table and 3 are taken, there is one left for you. By 4 or 5 years of age children can recognize that smaller numbers are 'hiding inside' larger numbers, seeing, for example, 2 and 3 hiding

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inside 5 (as are 4 and 1). While children tend to have many everyday experience combining and separating objects, they likely have far fewer experiences with composition in a number line-like context. Board games, like *Jumping on the Lily Pads*, add that context to their set of experiences and give children an additional framework for understanding number.

In *Jumping on the Lily Pads* children see, in the context of movement and distance, the same idea that they experience in adding more objects to an existing pile: a starting number (position or collection), plus a change (movement or extra objects), results in a new number (position or collection). For example, if children start on 3 and roll , encourage them to count starting at 3; “4, 5”—counting on from 3 will help them start to see that 3 plus 2 more is 5. If they are playing the advanced version of the game, they will be moving backwards in the number path too. For example, they may start on 7 and hop back , then land on 4. If children are on 2, and roll a , you can have them hop off the board and have a casual conversation about how 0 is less than 1 and what could be less than 0—negative 1! Children won’t formally learn about negative numbers until fifth or sixth grade but having an early informal introduction to the idea makes it more familiar later on.

Reciting number words in the correct order. Some children will know the number words but not be able to recite them in the correct order (i.e. 1, 2, 6, 4, 5, 10) or routinely skip a certain number (i.e. 1, 2, 3, 5, 6—always skipping 4). The *Jumping on the Lily Pads* game gives children enjoyable practice seeing and reciting the number list while jumping on or pointing to the lily pads. To reinforce this skill, recite the number list frequently in the day (when waiting for the bathroom, passing out or cleaning up materials) and listen to children recite it, helping them where needed. Many children benefit from hearing rhythm to the list: “one, two, three; four, five, six;...” Tone can give salience too, particularly when children are stuck on a certain number. Saying: “Let’s count together. One, two, three, four” each as if they’re anticipating something special, and then “five!” at the end as if it were the special surprise we were all waiting for. Then: “See, five comes after four! Now you do it!” *Jumping on the Lily Pads* provides a nice opportunity to do this as children jump their frog and then can eat the flies at 5.

One-to-one correspondence. One-to-one correspondence means connecting exactly one counting word to exactly one object. For example, a child counts three cubes as “one, two, three,” touching each object only once and assigning only one counting word to each. This is a more complicated endeavor than it appears, because it requires two kinds of matches: (1) “matching a moment of time when the action occurs and a word is said”; and (2) “matching in space where the counting action points to an object once and only once” (NCTM, 2010, p. 13). Young children often recite the words and touch the objects at different rates, going through the right actions—reciting and touching—but not yet with the right meaning. You can model the correct counting to help them remember that each object needs one point and one number word; you don’t skip any. Or you can say, “Did you get them all? Can you check?”

The *Jumping on the Lily Pads* game gives children experience moving their game piece one space at a time. This skill is related to counting one by one but in the context of movement over distance. You can notice if they subitize or just know how many dots are on the dot cubes

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when they roll, or are counting each dot with one-to-one correspondence, or are counting inaccurately.

Sometimes children seem to think that a line of five blocks with big spaces between them has “more” than another line with the same number of blocks but more tightly spaced. They may be confusing the size of the configuration of objects and the total number of objects. You can try having them imagine that the objects are small toys or treats (or something else they’d want a lot of), and ask which collection they would want and why. Without negating what the child *has* done correctly—counting the number and assessing the visual “size”—this gives the child one extra experience thinking about quantity; experience, over time, will solidify the child’s logic.

Subitizing. Subitizing is *instantly seeing how many* for small quantities. The game *Jumping on the Lily Pads*, encourages children to quickly see how many dots there are on the number cubes. The number cubes in this game have just 1, 2, and 3 dots which are quantities that children should be able to see quickly. Pay attention to whether the children are increasing in their ability to subitize these small dot quantities.

As a related skill, also notice whether some children can automatically see two jumps on the board and do not have to count each one. They may be able to move from 2 to 4 without having to count each jump. After you have seen them do that several times, it may be a good time to ask them to practice the counting on strategy. Instead of rolling a  and counting “1, 2, 3” as they jump, ask children to count on from the number their token is on. For example, if the frog is on 4, children count “5, 6, 7” as they jump—saying the names of the numerals they are jumping on. Practicing counting on like this helps get them ready for using that strategy for addition in elementary school.



OBSERVATIONS TO MAKE WHILE PLAYING

As you observe what your children are doing, support them to take the next step in their mathematical thinking by modeling, questioning, and explaining. Some items, like turn taking, seem not to be “mathematics.” They are not *arithmetic*, but success in mathematics involves much more than arithmetic. While mathematics is not at all about following rules, it *is* about noticing regularity and pattern, understanding the steps in a procedure and why they matter, keeping track of where we are in a sequence of steps, and thinking about the results of systems of rules. In a great deal of young children’s play, even play that involves no counting, we see them discussing, even disputing, the “rules.” When we call them “little lawyers,” they are also being little mathematicians, justifying their actions on what *they* see as logic, even if we don’t see logic the same way. This is very different from being arbitrary or willful and doing things “my way” with no justification.

<i>Do children</i>		<i>Do children</i>
<ul style="list-style-type: none"> Know that the top face of the dot cube tells them how many spaces to move? 	OR	<ul style="list-style-type: none"> Move their frog token to any space they want regardless of what they roll?
<ul style="list-style-type: none"> Take turns rolling the cube and moving their frog? 	OR	<ul style="list-style-type: none"> Move their frog when its not their turn or don't recognize when it is their turn or won't pass the dot cube to partner?
<ul style="list-style-type: none"> Jump lily pads on the game board one by one? 	OR	<ul style="list-style-type: none"> Jump lily pads on the game board not one by one (randomly or with some other agenda in mind)?
<ul style="list-style-type: none"> Count dots on the dot cubes one by one accurately? 	OR	<ul style="list-style-type: none"> Make mistakes in their counting such as skipping or double-counting dots?
<ul style="list-style-type: none"> Arrive quickly and efficiently at how many (subitize)? 	OR	<ul style="list-style-type: none"> Count one by one?
<ul style="list-style-type: none"> Recognize the numerals 1 to 5? To 10? To 12? (Which ones?) 	OR	<ul style="list-style-type: none"> Not yet recognize the numerals?
<ul style="list-style-type: none"> Consistently recognize the dot patterns on the dice? 	OR	<ul style="list-style-type: none"> Not yet retain the dot patterns on the dice?
<ul style="list-style-type: none"> Count on from where they are? (Start on 2, roll a 3, and count “3, 4, 5” to land on 5.) 	OR	<ul style="list-style-type: none"> Not count on, but count “1, 2, 3” regardless of the starting space?

BOOK LINKS

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Anno's Counting Book by Mitsumasa Anno

This beautiful illustrated book invites children to look closely to find all the ways the illustrator has integrated number into the drawings. The first page is zero—an empty winter landscape—and nothing to count. The next page is 1—one tree, one bird, one house. The next page is 2—two buildings, two trucks, two children, two men, 2 trees, and the clock is at 2 o'clock. As you turn each page notice the clock tower marking the hours, the number of blocks on the side of the page, and how the seasons change. Each page also corresponds to the months 1 to 12. Children can find mathematical ideas from the very simple to the complex in this book and can look at the pictures over and over again. Your class could create their own bulletin board like a page in *Anno's Counting Book*, making 5 of a variety of their favorite objects. There are more ideas about how to bring out the math in this book on the last page.

The Very Hungry Caterpillar by Eric Carle

This popular book is great for talking to children about 'how many in all' (cardinality) and comparing numbers. After you have read the book to the whole group, have book discussions in small groups. Ask the children questions such as "How many apples did he eat through? Pears? Plums? Strawberries?" See if they can name the total number rather than recount each time. Also notice if they are subitizing or counting one by one. Give the children practice comparing numbers by holding the book open to the pages that are cut out for each fruit. Ask children questions such as, "How many more pears did he eat than apples? How many more oranges than strawberries? How many more oranges than apples?"

Math extensions

- Compare the number of pieces of fruit the caterpillar ate through using the language more than and less than. Compare how many more or how many less.
- Notice if children are able to subitize the pieces of fruit in the book or have to count them one by one.

Art extensions

- Using lacing string (or pipe cleaners) and colored beads, have children string one red bead (apple), two green beads (pear), 3 purple beads (plum), 4 red beads (strawberries), and 5 orange beads (oranges). Have the children retell the story using their beads. Point out the growing pattern, one more bead in each segment.
- Draw a Caterpillar and have him have an ABAB (or other) pattern.
- Symmetry painting half a butterfly and folding him to make their other half.

Ten Black Dots by Donald Crews

Classic counting picture book: one black dot makes a sun, 2 black dots the eyes of a fox, and three black dots a snowman, etc. As you read, have the group count the dots on the page together. This book is a great compliment to the dot card games where kids are practicing one-to-one counting and subitizing. As an extension have kids put 1-10 circle stickers on a page and draw their own designs. You can use this book to extend the idea that numbers are composed of parts by finding the smaller numbers of dots that are part of the whole. For example, on the

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6 dot page one hand holds 3 new marbles while the other hand holds 3 old marbles—3 and 3 are 6. The train has 4 pairs of 2 wheels that make 8 wheels (dots) total.

***Fish Eyes: A Book You Can Count On* by Lois Elhert**

This counting book is a pleasure to read aloud with beautiful, vivid illustrations. The narrator imagines she has turned into fish and to “flip down rivers and splash in the sea.” On each page, children can count the fish 1 to 10. The little narrator fish includes a simple addition problem on each page such as, “4 striped fish plus me makes 5.” Children enjoy counting the fish or sometimes the fish eyes as you read the book. For a challenge, they can try the “plus one” problem on each page. At the art table, children would enjoy making their own illustration of fish to count. To make their fish, they could glue color bits of paper on to their page or use crayons, markers, or paint. Children enjoy narrating their own picture and having you write down what they say.

***Five Little Monkeys* by Eileen Christelow**

This fun book and song can be used to teach pattern, counting backwards, knowing one less, and understanding cardinality. For pattern, you can draw kids attention to the lines of the song that repeat each time and see if they know what changes—there is one less monkey jumping (rather than a growing pattern, it’s a shrinking pattern). You can ask children to act out the book by having five children pretend to be the monkeys and someone pretend to be the mama. They can see how the number of children (monkeys) jumping decreases by one each time the pattern (verse of the song) repeats. To practice the pairs that make 5, you can ask children how many monkeys *are not* jumping (if 3 are jumping, 2 are not jumping).

***How Many Snails?: A counting book* by Paul Giganti, Jr., illustrated by Donald Crews**

Walking to the meadow, lake, library, park, bakery, toy store, and other stops, the author wonders ‘how many?’ about a variety of different objects and in different combinations; such as: “How many snails were there? How many snails had striped shells? How many snails had striped shells and stuck their heads out?” This is a fun counting book to use as a read aloud and then for children to browse on their own counting all the objects and sorting them into different groups.

***Quack and Count* by Keith Baker**

The seven ducklings in the books split into all the whole number combinations that make seven. First children count all seven ducks, then the ducks slide, hide, chase, splash, and quack in the combinations $6 + 1$; $5 + 2$; $4 + 3$; $3 + 4$; $2 + 5$; $1 + 6$, and finally all seven fly. This book helps children understand that numbers are composed of smaller numbers. This is the same mathematical idea in the *How Many Are Hiding* game—numbers are composed of parts that make up the whole.

***Seashells by the Seashore* by Marianne Berkes**

Children walk along the beach gathering up seashells one by one and adding them to the collection that gathers on one side of the page. After reading the book to the whole class, have

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book discussions in small groups. Turn to a page and ask children how many shells the children have collected. Hold the sidebars of two pages next to each other and ask children on which page have they collected more and how many more. The shells are in the same orientation on each page which makes it easier to count and compare.

The Baseball Counting Book by Barbara Barbieri McGrath

Similar to an alphabet book, this book has a page for each number 0 to 20. It starts with the score is zero to zero; then one ball, one bat, and one call; then two teams; and at the end nineteen ice-cream cones to celebrate; and twenty baseball cards. After reading the book to the whole class, have book discussions in small groups. Children can practice counting the objects on each page as well as noticing that some numbers are bigger than others (i.e., 20 is much bigger than 2).



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