What's going on IN YOUR CHILD'S brain?

By **Katherine Reynolds Lewis**

Ever wondered what's going on behind your baby's gummy smile or that glint in your mischievous preschooler's eye? As it turns out, there's quite a lot going on inside a child's developing brain—and not all of it has to do with anticipating the next shot of milk or finding the nearest opportunity to create a mess. Inside their growing brains, billions of neurons are forming links with billions of other neurons, creating connections called synapses and shaping your child's understanding of the world around him. At age 1, a child has more synapses than at any other time of his life.

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From understanding gravity to knowing right from wrong, your little one grasps more concepts than you might expect

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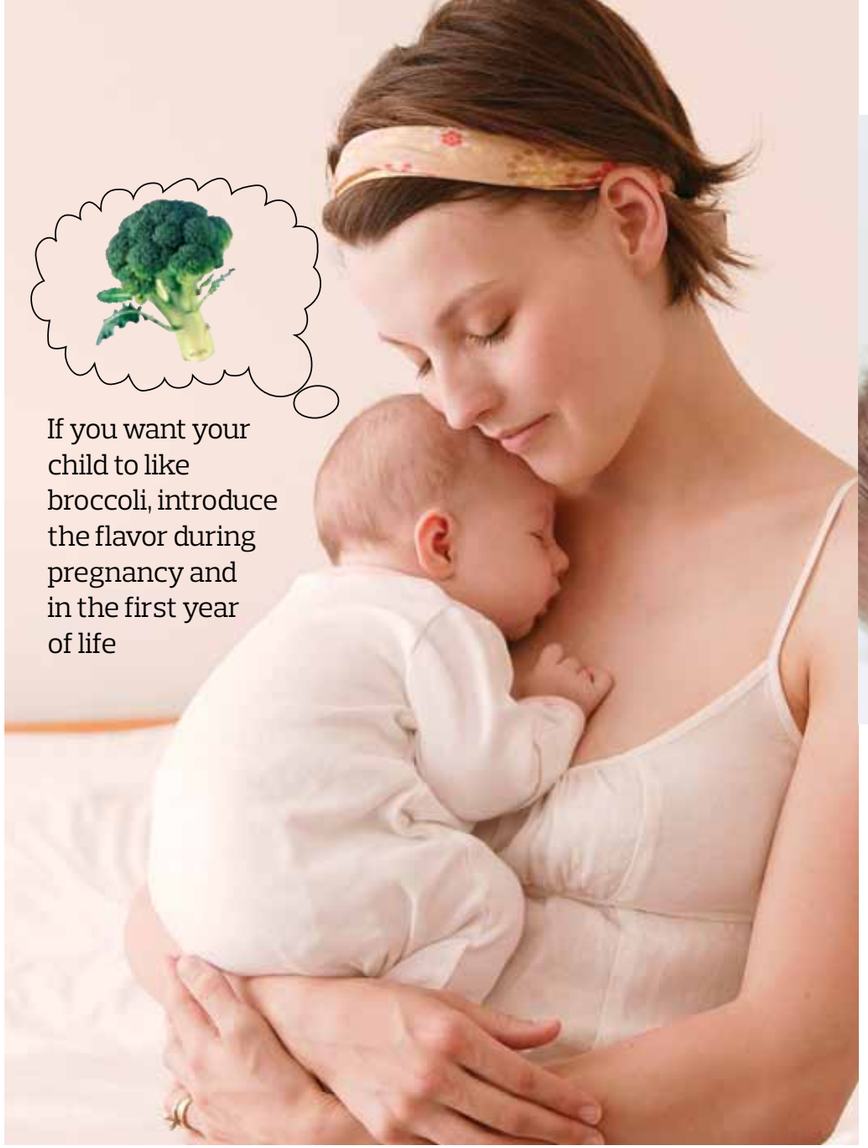
"EVEN WHEN BABIES LOOK LIKE THEY'RE JUST LYING there, there's an amazing amount of stuff happening in the first year of life," says Sam Wang, an associate professor at Princeton University and co-author of *Welcome to Your Child's Brain: How the Mind Grows from Conception to College*.

Neurologists and developmental scientists have demonstrated that babies and small children are more aware of the emotions of the people around them than you might expect. They also have a sense of ethics, and even babies can tell good guys from bad guys. And recent research shows that small children understand rudimentary physics and can perform arithmetic and create ratios in their heads.

"What's exciting about this is that babies seem a lot smarter than most people think," says Kristy vanMarle, an assistant professor of psychological sciences at the University of Missouri who recently co-wrote a review paper on infants' knowledge of physics. "Babies have some pretty sophisticated knowledge from pretty early on, suggesting that they understand quite a bit about how objects work in the world. In particular, they seem to understand the physical principles of how objects act and interact."

All of this growth and development demands serious energy. "Half of a child's energy budget goes to operate the brain," compared with one-sixth of an adult's energy, says Wang, who has a 4-year-old daughter. "It's mind-blowing. Every other bite I put in her mouth is going to run her brain."



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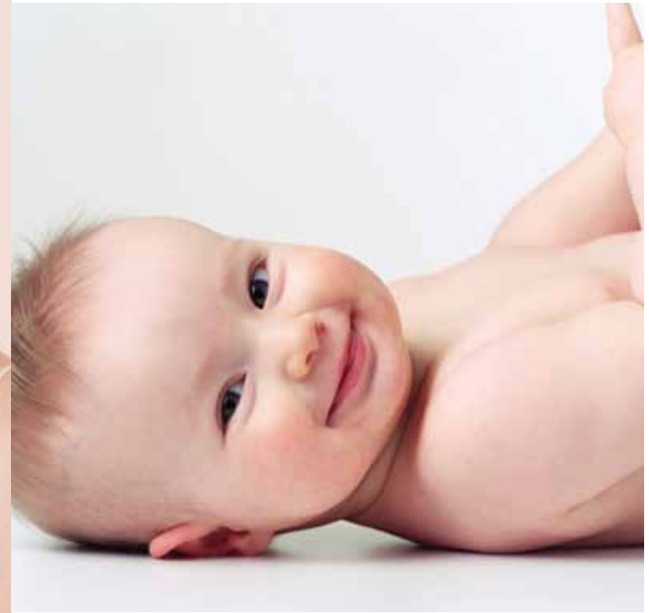
NEWBORN

WHEN A BABY IS BORN, SHE CAN RECOGNIZE HER MOTHER'S VOICE. In the first days of life, a baby expresses a preference for faces over other shapes and for human voices over other sounds, Wang says.

Babies can detect emotions and mirror them through a phenomenon known as contagious emotion. "If you've ever been with a bunch of babies in a nursery, if one of them cries, all of them cry," he notes.

"They also have some ability before birth to form ideas of what's familiar," Wang says. "Women who eat garlic during pregnancy have babies who are more likely to accept garlic-flavored milk."

So if you want your child to like broccoli, introduce the flavor during pregnancy and in the first year of life. If you breastfeed, simply include many vegetables in your own diet. If you formula feed, you can use soy formula, which has a slightly bitter taste that mirrors the flavor of some vegetables. "Babies who get that before age 1 are more likely to accept vegetables at age 4," Wang says.



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"Babies have all these learning capacities for absorbing information from the environment around them."

Sam Wang, co-author of *Welcome to Your Child's Brain*

THREE MONTHS

BABIES BEGIN TO DEVELOP AN UNDERSTANDING OF ETHICS early on. "Even a young baby, at 3 months of age, can still figure out who is good and bad and what is right and wrong, way before parents are teaching their kids these things," says Kiley Hamlin, a psychology professor at the University of British Columbia who conducts infant research.

To test this understanding, researchers put on a puppet show for babies in which a puppet is playing with a ball, drops it, and gestures for a second puppet to return it. In one scenario, the other puppet helps out by retrieving the ball; in the other scenario, the second puppet takes the ball and runs offstage. Researchers recorded the babies' response to each puppet by measuring variables like how long the babies gazed at each puppet and which puppet the babies reached for. After viewing the show, almost all the babies preferred the helpful puppet over the selfish puppet, says Hamlin.

Babies also learn to respond to cues from the people around them. Three-month-old babies can follow another person's gaze, turning their head to look where the other person is looking.

And babies know about gravity. While they expect unsupported objects to fall, their initial understanding of physics is imperfect and continues to grow as they get older. For instance, 2- to 3-month-old babies believe that an object that makes contact with a supported surface, like a table, won't fall, even if it's only touching on the side. "A couple of months later, they seem to understand that the object being supported has to be on top of the other object," vanMarle says.

Your child's development

A timeline of typical developmental milestones *(Note: Each child grows at his or her own pace)*

0–6 MONTHS

- **Can relate what they hear** with what they see, such as drawing a connection between a mother's face and voice
- **Attempts to get objects** that are out of reach
- **Able to differentiate** between familiar and unfamiliar faces
- **Capable of making predictions** and creating and testing hypotheses about the world, such as shaking a rattle to make a noise

6–12 MONTHS

- **Understands that a hidden object** continues to exist (a concept known as object permanence)
- **Explores objects** with actions like shaking, banging, throwing, and dropping
- **Attempts to use items** in the way they see others use them(like phones and cups)

1–2 YEARS

- **Recognizes the difference** between self and others in mirrors, in photos, and on video
- **Begins to pretend** in play, imitating the actions of others
- **Starts to show empathy** and embarrassment
- **Can identify** a picture by its spoken name

3–5 YEARS

- **Acts out increasingly** inventive pretend scenarios
- **Begins to verbally count** and identify shapes
- **Gains an understanding** of time

SOURCE: PARENTING COUNTS AND TEACHING STRATEGIES

The more different words an infant hears every day, the sooner she is likely to begin to speak.

SIX MONTHS TO TWO YEARS

IN THE SECOND HALF OF THEIR FIRST YEAR, babies develop a more sophisticated understanding of right and wrong. To study this concept, researchers had babies watch puppet shows with a variety of nice–mean scenarios. At this stage, "babies like those who are mean to bad guys just as much as they like good guys," says Hamlin.

They show a preference for their native tongue, beginning with vowels that are specific to the language spoken around them. Thus, an American baby will babble very differently than a Swedish baby. The more different words an infant hears every day, the sooner he likely will begin to speak and the larger his vocabulary will grow. "There's a cognitive advantage to play dates because the adults are having a conversation," Wang says, noting that the words have to come from a live person, not a television.

Around a baby's first birthday, he starts to differentiate men and women, cats versus dogs, and animate objects from inanimate objects. Babies also prefer women to men, unless they have a male primary caregiver. "They have all these learning capacities for absorbing information from the environment around them," Wang says.

TWO TO FIVE YEARS

AFTER TURNING 2, CHILDREN START TO UNDERSTAND and weigh people's ethical intentions. "[They] prefer those who try to help but fail such that the outcome is bad over those who try to harm but fail," Hamlin says. "It's about your intentions and not the outcomes."

Around the age of 3, children begin to develop "theory of mind," which is the ability to imagine someone else's intentions, Wang says. In a classic experiment, a researcher hides a toy or treat and leaves the room. A second researcher then moves the object. When the first researcher returns, the child is asked where he expects the researcher to look for the object.

"Before age 3, the child points to where the object is currently hidden," Wang says, because he doesn't realize that the researcher has less information than he does. "At age 4, they start having a clearer idea. They are able to start imagining the thoughts of others."

Parents can build on this budding empathy by encouraging children to act out plays. Research also indicates that younger siblings develop theory of mind 4 to 6 months earlier than older siblings, Wang says, a phenomenon not replicated by simply having other children as playmates.

And if you're planning on introducing a foreign language, the best time is before age 6, says Wang. At this age, a child can most easily learn native idioms and slang. "You have a sensitive period for language acquisition," Wang says, because a child's rapidly forming brain is more malleable and able to form new neural connections. "If you wait until after puberty, it's much harder."

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