Criteria Report

Research-Base for Ignite by Hatch™

May 2021

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About Hatch Early Learning

Hatch's mission is to ignite lifelong learning and close the achievement gap. Founded in 1984, Hatch placed some of the first ever computers in preschool classrooms throughout the southeast. Originally distributing third party content and hardware, Hatch has evolved into a leader in early learning technology solutions, developing our own research-based, proprietary content for children ages 3 to 6.

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Ignite™ Overview

Ignite by Hatch™ is a powerful, research-backed, play-based digital learning platform that supports children's development and learning within seven domains of development. Offering the flexibility of continuous learning at home and in classrooms, Ignite™ provides teachers actionable reporting on each child, no matter where they playing. This data, paired with the instructional supports provided in Hatch® Insights, supports teachers in implementing data-driven instruction aimed at helping all children reach their next milestone.

- Ignite™ is comprised of play-based digital learning experiences that engage, instruct, and assess children in seven domains of development.
- Hatch® Insights provides robust real-time data reporting from Ignite™. This data allows teachers to monitor progress at the child and classroom level, no matter where children are using Ignite.
- Built-in Entry and Exit Skill Check-ups help teachers individualize instruction from the start and measure growth of each child over the school year.
- Insights offers teacher-led curricular experiences that support the skills children are learning in Ignite™. Insights even suggests ways to group students for maximum instructional impact.
- Family Connections Experiences encourage families to help build and reinforce kindergarten readiness skills at home.
- Ignite™ is compatible with most touch-screen devices. Because children use the same photo-based login, Ignite™ tracks their progress continually, even across multiple devices.

Introduction

Hatch Early Learning utilizes the latest research and theory to inform the development of Ignite™. This report provides a review of the research literature used to develop the skill descriptors that serve as the base of Ignite™.

The development of content for Ignite™ begins with a thorough review of the relevant research and state and federal early learning standards. The review of this wide knowledge base aims to answer three main research questions:

1. What are the significant skills young children develop?
2. In what order and by what age to children typically develop these skills?
3. How do children develop these skills?

Using the findings to these research questions, Hatch content experts develop a sequence of skill descriptors within each subdomain that represent the skills young children develop within the subdomain and the order in which they develop them. These skill descriptors drive the development of digital experiences, teacher-led curricular experiences, and family connection experiences.

This report provides a summary of the findings to the research questions outline above organized by domain and subdomain. Each section of this report begins by describing the general nature of the domain and the broad skills within it. This is followed by a dive into each subdomain within the domain. After a synthesis of the research related to the subdomain is the list of skill descriptors for the subdomain.

Hatch Early Learning provides this report to support the quality of Ignite™ and to provide transparency into the research base used to develop Ignite™.

Social Studies

There has been a renewed focus in early childhood education and K–12 education on educating both the whole child and preparing students for the rigors of college, career, and life in the 21st century. The emphasis on "21st century skills" is not limited to the domains of children's science and technology learning; if anything, "21st century skills" of inquiry, analysis, critical-thinking, active engagement in life at school, at home, in the community, and beyond begin with children's social learning, their understanding of themselves, their knowledge of their lives, awareness of the many communities they are a part of, and responsible participation as a citizen of the United States and the world (NCSS, 2017).

Even in early childhood, children's social studies learning is multifaceted, involving three categories of development and learning:

1. Knowledge: what learners need to understand
2. Processes: what learners will be capable of doing
3. Products: how learners demonstrate understanding (NCSS, 2010a).

In their position statement on developing state and local social studies standards (2014), the National Council for the Social Studies notes that the priority for students' understanding of social studies is learning:

> *That supports critical thinking and disciplinary habits of mind, important features for preparing young people to make informed and reasoned decisions for the public good as citizens of a culturally diverse, democratic society in an interdependent world.*

The National Curriculum Standards for Social Studies (National Council for the Social Studies, 2010) are a framework to inform what is taught in the classroom from prekindergarten through grade 12. The focus is on students "learn(ing) a body of knowledge, and to be able to think flexibly and act responsibly to address civic issues in a diverse and interdependent world" (n.d.). This framework provides ten themes/ten ways to consider social studies learning, i.e., "the human experience in the world." (NCSS, 2020; Swan et al., 2013).

1. Culture
2. Time, continuity, and change
3. People, places, and environments
4. Individual development and identity
5. Individuals, groups, and institutions
6. Power, authority, and governance

7. Production, distribution, and consumption
8. Science, technology, and society
9. Global connections
10. Civic ideals and practices

Social studies learning ensures children become "21st century citizens of the world" as they develop and refine their understandings of their lives and that of others, engage in inquiry and wonder, and consider their impact on the world around them: in school, at home, and in their community.

Given the review of relevant research related to young children's development of skills within social studies, Ignite™ includes two subdomains within social studies: Self-Identity and Community Awareness. These two subdomains serve as the foundation of social studies development.

Self-Identity

Children's formation of both self-identity and community are fostered in developmentally appropriate early childhood programs and schools. Two of the principles of the Head Start Early Learning Outcomes Framework involve honoring and strengthening children's self- identity and their community backgrounds (U.S. Department of Health and Human Services, 2015). The first principle acknowledges that each child is unique and can be a successful learner; the second principle states that there are differences in learning, cultural background (i.e., the child's cultural community), and language. (O U.S. Department of Health and Human Services, 2015).

Children's awareness and then understanding of their self-identity involves developing their knowledge of self. Knowledge of self includes understanding that:

- You are an individual with unique characteristics that make up who you are as a person.
- You have your own personality traits, interests, preferences, strengths, and needs.
- You have a preferred learning style, a preferred way of communicating.
- You have a unique family (with its culture, history, attitudes, customs, preferences, occupations, and celebrations) (U.S. Department of Education, 2015; NCSS, 2010a, 2010b, 2010c, 2017, 2019).

As a child's sense of self develops, he/she understands that each person is their own independent self with their own unique characteristics, etc. As children find similarities and differences with themselves with others, they will also begin to reflect on themselves as individuals and make connections such as all persons have basic needs that must be met to live. This awareness of self

and others "allows young learners to explain relationships with other people, to institutions, and to the environment, and equips them with knowledge and understanding of the past" (NCSS, 2020).

Using the review of research and state and federal early learning standards, Ignite™ contains the following skill progression for the Self-Identity subdomain:

Skill Level	Skill Descriptor
1	Draws a self-portrait
2	Draws a picture of his/her home
3	Draws a picture that resembles his/her family
4	Identifies various characteristics and interests that appeal to him/herself
5	Draws a self-portrait with (at least one) characteristic or interests included

Community Awareness

Children's understanding of community builds off their understandings of self-identity and knowledge of self, moving towards knowledge of community.

Knowledge of Others (the Community) includes understanding that:

- People have similarities and differences in their interests, habits, homes, needs, strengths, family structures, their roles at home and in the greater community.
- There are many different types of families, of jobs, of places to live and call home, transportation (CA Dept. of Ed., 2013, 2017; CO Dept. of Ed., 2020a; FL Dept. of Ed., 2014; NCDPI, 2010, 2013a, 2013b; NCSS, 2010, 2017, 2019).

Young children's development, learning, and understanding of self and of community are the foundation for history learning: as they "develop an understanding of different perspectives, define identity" and "develop critical thinks skills…to explain the human experience" (Colorado Department of Education, 2020a).

Using the review of research and state and federal early learning standards, Ignite™ contains the following skill progression for the Community Awareness subdomain:

Skill Level	Skill Descriptor
1	Draws a picture of a neighborhood
2	Identifies characteristics of a neighborhood
3	Shows understanding of how places and things within a neighborhood are commonly utilized

4	Demonstrates understanding of physical features of neighborhoods/communities
5	Identify community helpers (within a community/neighborhood)

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Science & Technology

Young children are innate scientists. Their natural way of play involves a great deal of curiosity, experimentation, and observation. This way of exploring the world naturally lends itself to the acquisition, building, and refining of scientific concepts. These explorations are hands-on and minds-on for, "engaging in scientific investigation requires not only skill …" (NSTA & NGSS, 2013) but "the range of cognitive, social and physical practices it (scientific inquiry) requires" (Huff, 2016).

The foundation for children's scientific understanding and learning is daily, authentic opportunities to "engage in the practices of science" in meaningful and relevant, (i.e., real- world applications during content study). For young learners, science understandings involve learning, thinking, and doing as children: demonstrate first awareness of, then knowledge of, and finally understanding of and questions about science concepts and science practices.

In preschool and early elementary grades, children's knowledge and understandings of science content areas, scientific concepts and practices develop through:

- Interactions and experiences with living things and the physical world around them
- Experimentations and investigations of natural forces
- Experiences with nature
- Observations and reflections on what they see, notice and wonder about (NGSS, n.d, 2013; NSTA, 2011, 2014, 2018b,2020).

Given the review of relevant research related to young children's development of skills within science, Ignite™ includes four subdomains within Science and Technology: Life Science, Physical Science, Earth Science, and Simple Tools and Technology.

Life Science

There are several components to knowledge and understanding of life science in young children. Children begin to understand concepts of living things (organisms) and nonliving things, as well as different and various categories/classifications of living things. They also begin to understand characteristics and development of organisms through life/growth cycles. Children learn about hereditary (inheritance and variation) traits of living organisms. In addition, they can recognize that different organisms belong to

different environments, and there is an interdependence of living things (ecosystem) (NGSS, n.d, 2013; NSTA, 2011, 2014, 2018b, 2020).

Being that the foundation for children's scientific understanding and learning is rooted in everyday engagement with world around them, life science in early childhood must contain concepts that young children are familiar with and/or have opportunities to explore. This builds off their innate awareness of the world around them, helping them move to higher levels of knowledge and understanding.

Aligning research with state and federal early learning standards suggests that children develop life science knowledge and understandings in the following progression:

- Children 2-3 years of age show understanding of different characteristics of people and properties of objects through play and exploration.
- Children 3-4 years of age show understanding of how they can use their five senses to observe and explore various living things and natural processes and can use basic adjectives to describe characteristics of such organisms.
- Children 4-5 years of age show understanding of and are able to compare and contrast the basic needs of living organisms (I.e. plants need sunlight, nutrients, air, and light whereas an animal needs water, food, shelter). They are also able to life cycles of plants, animals, and humans.
- Children 5-6 years of age show are able to make increasingly complex observations about many different organisms and are able to compare and contrast organisms' basic needs and growth/life cycles.

Using the review of research and state and federal early learning standards, Ignite™ contains the following skill progression for the Life Science subdomain:

Skill Level	Skill Descriptor
1	Identifies at least one living thing
2	Identifies at least 3 living things
3	Identifies living things and begins to identify their basic needs (air, water, food, shelter)
4	Identifies how living things change over time
5	Identifies living things and their basic needs, and how they grow and change over time

Physical Science

As natural born scientists, children's first opportunities to learn about and understand the world are through physical sciences. Young children's utilization of the five senses (touching, tasting, smelling, hearing, seeing) provide organic opportunities to experiment with the physical world. Components found in understandings and knowledge of physical science include: physical properties of objects and materials, natural forces that impact objects and materials, motion (and stability) of objects and forces and interactions (different ways objectsmove/ can be moved), energy, matter, and concepts like light, heat, electricity, magnetism, and gravity.

Aligning research with state and federal early learning standards suggests that children develop physical science knowledge and understandings in the following progression:

- Children 2-3 years of age begin to show understanding of basic objects and their characteristics through play and exploration using their senses.
- Children 3-4 years of age show understanding of all five senses (touching, tasting, smelling, hearing, seeing), and can begin to use these senses to use increasingly complex language in comparing and contrasting objects.
- Children 4-5 years of age show understanding of how the five senses can be used to purposely sort or classify objects based on one or more properties. They are also able to describe some ways in which properties or substances might transform given certain variables (I.e. heat melts an ice cube)
- Children 5-6 years of age show understanding of increasingly more complex characteristics of objects, including their physical properties, how they move, or transform given certain variables. Children in this age group are able to meaningfully sort, classify, or place objects into groups based on characteristics.

Using the review of research and state and federal early learning standards, Ignite™ contains the following skill progression for the Physical Science subdomain:

Skill Level	Skill Descriptor
1	Identifies at least 3 of the 5 senses and can identify a property of natural and/or humanmade material (I.e. cotton, fur, wood, etc.)
2	Identifies 4 of 5 senses and demonstrates understanding of texture of materials (I.e. sandpaper, salt, flour, etc.)
3	Identifies 5 senses and demonstrates understanding of what our senses do)

4	Sorts, groups, or classifies objects based on one or more properties (I.e. hard/soft or heavy/light; materials that are made of – wood, plastic, rock)
5	Identifies the effects magnets have on some items (I.e. magnets attract some things, but not others)

Earth Science

Earth science understandings and knowledge develop as children engage with the natural world. The most basic components of earth science include the composition and structure of the Earth (water, dirt, rocks, sand). Children also begin to explore how earth plays a part in space and time (I.e., developing understanding of other objects in the sky, how the earth moves, how movement of earth creates day/night or season changes). Young learners also develop a basic knowledge of weather (I.e., different types of weather, patterns and variations in weather, reasons for weather change, and weather in different parts of the United States or other countries). Children demonstrate knowledge that people can affect earth positively and negatively, and have increasing awareness of various actions that impact Earth and the environment positively and negatively (NGSS, 2017; NRC, 2012; CA Dept. of Ed., 2013; CO Dept. of Ed., 2020a; NCDPI, n.d.)

Aligning research with state and federal early learning standards suggests that children develop earth science knowledge and understandings in the following progression:

- Children 2-3 years of age begin to show understanding of the basic compositions of the earth (I.e., water, dirt, rocks, and sand).
- Children 3-4 years of age show understanding of basic patterns on earth; they can identify patterns relating to weather or day/night.
- Children 4-5 years of age show understanding of the effects of a weather event on earth (I.e., leaves blowing after a gust of wind occurs, erosion of dirt on the sidewalk after rain) and can identify shadows using the sun as a light source.
- Children 5-6 years of age show increased understanding of repeating earth patterns (I.e., seasons, day and night) and can compare and contrast these patterns with other parts of the world. Children may also show an increased awareness of how components of the earth are used in the environment.

Using the review of research and state and federal early learning standards, Ignite™ contains the following skill progression for the Earth Science subdomain:

Skill Level	Skill Descriptor
1	Identifies materials in the environment

2	Identifies changes and properties in the Earth's environment
3	Analyzes patterns in weather and the effects of weather on the Earth's environment
4	Evaluates changes to Earth's environment
5	Demonstrates understanding of causes and the effects of the environment

Simple Tools and Technology

Young children's knowledge and utilization of simple tools and technology aid in further investigation and exploration about the world around them. Children in early childhood are beginning to acquire knowledge of a wide variety of standard and non-standard tools and technology. Standard tools understood by young children may include a ruler, balance scale, eye dropper, thermometer, magnifying glass, binoculars, or stethoscope. Non-standard tools used by young children include scoops, drinking cups, unifix cubes, or paper clips. Digital or technology tools may include a tablet, smartphone, computer, art and design and word processing programs. Children in early childhood begin to demonstrate recognition that technology/digital tools are "modern tools", and can be used when learning, investigating, exploring, and wondering. Children can identify differences and similarities between tools, and how, why, and when to use them. Young children can also demonstrate awareness that tools can be used effectively or ineffectively, as well as explain why or why not. Additionally, children begin to develop increasingly complex understanding that digital tools and technology can inform/be used to solve a problem, design a solution, or create something new. (NGSS, 2017; NRC, 2012; CA Dept. of Ed., 2013; CO Dept. of Ed., 2020a; NCDPI, n.d.)

Aligning research with state and federal early learning standards suggests that children develop knowledge of simple tools and technology in the following progression:

- Children 2-3 years of age begin to, with support, utilize simple non-standard measurement tools to quantify, compare, and contrast objects.
- Children 3-4 years of age show understanding of simple standard and non-standard measurement tools to quantify, compare, and contrast objects.
- Children 4-5 years of age show understanding of and utilize tools such as a ruler, balance scale, eye dropper, unit blocks, thermometer, or measuring cup to quantify objects.
- Children 5-6 years of age show increased understanding of the uses, purposes, and appropriateness of specific tools to related tasks or

needs. Children at this age understand that tools can be used to extend their five senses (I.e., magnifying glass) during observations.

Using the review of research and state and federal early learning standards, Ignite™ contains the following skill progression for the Simple Tools and Technology subdomain:

Skill Level	Skill Descriptor
1	Identifies simple tools in everyday life
2	Demonstrates understanding of the uses of simple tools in everyday life
3	Explores simple science tools and their uses
4	Identifies simple science tools
5	Demonstrates understanding of the uses of simple science tools

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Social-Emotional Development

Children's social–emotional development – particularly in the first three years of life and in the early elementary grades – plays a powerful role in their cognitive development. Social-emotional understandings inform and strengthen the "school readiness skills" so essential for children's success in school and in life. Researchers Bettencourt & Ho detail school readiness skills "essential for learning in a classroom setting" as "follow directions, comply with rules, manage emotions, solve problems, organize and complete tasks, and get along with others" (2016). Social-emotional development influences children's critical-thinking skills, their approaches to learning, their resiliency, and engagement in learning now and in the future.

When children's social–emotional needs are recognized and met by their teachers consistently and in a caring way, children know they are respected members of the classroom. Students understand that they not only can get help, support, and guidance for their teachers, but can help themselves and support and take care of others in the classroom. By nurturing and encouraging children's engagement in and refinement of their social–emotional skills, teachers empower children to become active participants, helpers, and classroom community members.

Children's social–emotional development involves:

- Emotional regulation and behavioral skills
- Positive behaviors
- Positive attitudes towards others
- Benchmarks for social-behavior readiness (and positive engagement in learning) and readiness to learn (Bettencourt, Gross, & Ho, 2016; Hamre & Pianta, 2001; Lam & Wong, 2017; O'Connor et al., 2011)

These skills and understandings are closely interconnected, supporting, and bolstering each other:

> *Children internalize a set of social-emotional skills and strategies that enable them to understand and manage emotions, set and achieve goals, appreciate the perspectives of others, feel and show empathy for others, establish and maintain relationships, make responsible decisions, and handle interpersonal situations constructively (Kirk & Jay, 2018).*

Positive reinforcement and acknowledgement of when a child manages and responds appropriately to his emotions or deals with a situation is a powerful motivator for children. This recognition strengthens children's sense of self and their own agency.

Children's growing understanding of the emotions and experiences of others helps them develop empathy. Empathy builds and sustains positive and meaningful relationships and strengthens children's critical-thinking skills as they consider and reflect upon the feelings and needs of others. As young children grow, they refine their understanding of how people experience and respond to varying emotions, while also knowing that their own personal emotional experiences and responses can be different (Jones, McGarrah, & Kahn, 2019; Kaiser & Sklar Rasminsky, 2017).

This empathetic understanding and responsiveness to the feelings and reactions of others strengthens children's prosocial skills which in turn leads to more positive interactions with other children. By the time children enter kindergarten, they are typically demonstrating prosocial behaviors without much support, prompting, or guidance from adults as in preschool.

Children's social competence and interpersonal skills are critical for a "successful progression in early grades (Jones, Greenberg, & Crowley, 2015):

> *Children with strong social skills are more likely to make and sustain friendships, initiate, positive relationships with teachers, participate in classroom activities, and be positively engage in learning. (Jones, McGarrah, & Kahn, 2019)*

Children's strong social skills are continually bolstered and influenced by meaningful relationships with their peers and their teachers and reinforce children's understanding of themselves as valued learners in the classroom community (Dixon, 2016).

Given the review of relevant research related to young children's social-emotional development, Ignite™ includes two subdomains within Social-Emotional Development: Identifying Emotions and Solving Social Problems.

Identifying Emotions

Children's understanding and identification of emotions is the foundation for their growing self- awareness – "the ability to accurately recognize one's own emotions and thoughts" (CASEL, 2019) and to know of themselves as unique, independent, and important individuals.

Young children's growing ability to identify their emotions and the emotions of others influences children's behavior and actions in response. Young preschoolers can identify basic emotions in themselves and others. In late preschool through kindergarten, children can identify their emotions and the

emotions of others, including more subtle emotions (unsure, perplexed) and complex emotions (worried, embarrassed). In kindergarten and first grade, children understand and know the causes of both their emotions and that of others, even if a reaction or emotion of another child is different from their own emotion and reaction. It is in the early elementary grades that children's analytical understandings of emotional differences – reactions and approaches – develop. By first grade, children implicitly know (and understand) that people have different emotions than their own.

Throughout the kindergarten year, children's growing ability to understand their emotional lives – their feelings, needs, wants, and interests – strengthens and reinforces their overall emotional functioning as they express, manage, and respond to their feelings and that of the feelings of others.

Not only are children able to identity a wide range of emotions in others, but they are also more aware of and responsive to the feelings (and needs) of others (children, family members, teachers, caregivers, and characters in the books). They will provide reasons for the causes these feelings and propose ways they can help others. This social self-awareness (and independent responsiveness) are critical skills for children from first grade on as they interact and work collaboratively with their classmates (Ashdown & Bernard, 2011; Bettencourt, Gross, & Ho, 2016).

Aligning research with state and federal early learning standards suggests that children develop knowledge of identifying emotions in the following progression:

- Children 2-3 years of age show understanding of basic emotions; identifies wants and needs of themselves and others
- Children 3-4 years of age show understanding of more broad range of emotions in different contexts; identifies more subtle emotions in themselves and others
- Children 4-5 years of age show understanding of more complex emotions; identifies how actions affect the emotional responses of others
- Children 5-6 years of age show increased understanding of complex emotions, even if an emotion or emotional response is different than what their own response would be.

Using the review of research and state and federal early learning standards, Ignite™ contains the following skill progression for the Identifying Emotions subdomain:

Skill Level	Skill Descriptor
1	Identifies basic emotions (happy, sad, angry/mad, and scared)

2	Demonstrates causes of basic emotions
3	Identifies more complex emotions (calm, surprised, embarrassed, and disappointed)
4	Demonstrates causes of more complex emotions
5	Demonstrates knowledge of how to be supportive of others' emotions

Solving Social Problems

Children's ability to solve social problems is a "key skill that young children need as they enter school" (Shonkoff & Philips, 2000; Ashdown & Bernard, 2011). It is considered an essential social development skill that not only prepares children for the learning in the later elementary grades and beyond but ensures children's positive engagement in learning (Hamre & Pianta, 2001), their overall positive behaviors in the classroom, at school, and at home, and their positive attitudes towards themselves and others (Lam & Wong, 2017).

Young preschool children are able to identify another child's wants or needs and can share with others using the support and guidance of caregivers. Older preschool children begin to anticipate potential social problems, such as sharing, and propose solutions and strategies to prevent a social problem or conflict from even occurring. This demonstrates children's growing ability to reflect, consider, and then act accordingly and responsively. Children in early elementary school have the ability to recognize and respond to the interests, wants, and desires of others even when it may conflict with their own needs and wants. This willingness to be responsive to the needs and wants of others demonstrates children's understanding of themselves as part of a larger group: the classroom community.

As children learn how people respond and react differently to emotions and situations, they also begin to develop an understanding of their own self as an independent thinker and doer and realize that others are also independent thinkers and doers. This self-awareness of self and others not only reinforces children's critical-thinking skills, but also ensures children's ability to form positive and meaningful relationships with others and to problem-solve and resolve social problems.

Aligning research with state and federal early learning standards suggests that children develop knowledge of solving social problems in the following progression:

- Children 2-3 years of age show understanding of and can respond to the wants and needs of others
- Children 3-4 years of age show the ability to anticipate social problems and can initiate pro-social strategies (I.e. sharing)

- Children 4-5 years of age show understanding of pro-social behaviors across many contexts including negotiation, taking turns, and sharing; shows understanding that actions have consequences and can anticipate the emotions of others
- Children 5-6 years of age show increased understanding of prosocial behaviors; children are able to recognize and respond to the interests of others even when it conflicts with their own interests by using regulation strategies

Using the review of research and state and federal early learning standards, Ignite™ contains the following skill progression for the Solving Social Problems subdomain:

Skill Level	Skill Descriptor
1	N/A
2	Identifies pro-social behaviors
3	Responds to others' feelings appropriately
4	Identifies appropriate solutions to social conflicts
5	Identifies strategies for addressing their own emotions in social situations

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Language & Communication

Language experiences in the early years of development have a tremendous influence on children's future success. It is critical to view language and communication as a vehicle in which children use to develop meaning about the world around them. Providing children with many opportunities to listen to rich language and experience exchanges in communication secures the foundation for later learning. These opportunities allow for the internalization of many levels of the language system; developing abilities in perceiving discourse, syntax, and vocabulary (Dickinson et al., 2003). Language is also interconnected with literacy, and children who engage with more meaningful language experiences are more successful in reading later on (Dickinson et al., 2003).

Language and communication occur in a developmental progression, with children increasing their understanding of vocabulary and complexity of sentence structure over time. As young children listen to language through conversational exchanges or literature, they begin to develop and build upon a contextual knowledge and vocabulary base that aid them in understanding messages through print (Neuman & Carta, 2011). Between 24 and 48 months of age, children show increased understanding of the meaning and relationships between words as well as grammatical forms (Scarborough, 2001). This later develops into "using proper grammar (conventions of language), using compare-contrast text structures (reading comprehension), and building sophisticated paragraph structures (writing)" (U.S. Department of Education, 2014.) Children's ability to formally read and comprehend words depends substantially on their deep understanding of the language used to communicate through a text (National Research Council, 2015).

Given the review of relevant research related to young children's language development, Ignite™ includes three subdomains within Language and Communication: Receptive Language, Listening and Understanding, and Vocabulary.

Receptive Language

Receptive language is the input of language, the ability to understand and comprehend spoken language that is heard or read. Children's receptive language development begins before their expressive language ("the output of language, the ability to express wants and needs through verbal or nonverbal communication. It is the ability to put thoughts into words and sentences in a way that makes sense and is grammatically correct") (Vollmer, 2020).

Receptive language skills and understandings primarily involve children's spoken responses to questions, prompts, and comments (beginnings of collaborative conversations and critical- thinking discussions). Aligning research with state and federal early learning standards suggests that children develop receptive language skills in the following progression:

- Children 2-3 years of age show understanding of words and phrases as well as simple sentences in a familiar context.
- Children 3-4 years of age show acknowledgement of comments or questions and can answer simple questions that show knowledge of events.
- Children 4-5 years of age show acknowledgement of more complex comments or questions and can answer open-ended questions.
- Children 5-6 years of age show understanding of question words (e.g., who, what, where, when, why, and how) and words for time (e.g., yesterday, today, and tomorrow).

Using the review of research and state and federal early learning standards, Ignite™ contains the following skill progression for the Receptive Language subdomain:

Skill Level	Skill Descriptor
1	Shows understanding of basic words
2	Responds to "what" questions
3	Responds to "where" questions
4	Demonstrates understanding of complex and compound sentences
5	Responds to "how" questions

Listening and Understanding

Listening comprehension (i.e., listening and understanding) refers to a student's ability to follow, process, and understand spoken language. From infancy, children's exposure to conversational exchanges is foundational to their development in attuning to language. The Head Start Early Learning Outcomes Framework suggests that young preschoolers are able to understand simple questions and commands, progressing to increased understanding of more complex sentences and multi-step directions (U.S. Department of Health and Human Services, 2015). According to the National Institute of Health (2000) speech and language developmental milestones, five-year-old children can carry out a series of three directions and comprehend compound and complex sentences.

Aligning research with state and federal early learning standards suggests that children develop listening and understanding skills in the following progression:

- Children 2-3 years of age show understanding of simple sentences used in conversation and can carry out simple directions in a familiar context.
- Children 3-4 years of age show understanding of and respond (verbally and nonverbally) to sentences longer in length and can follow two-step directions.
- Children 4-5 years of age show understanding of multi-step directions, and increasingly complex sentences and respond appropriately.
- Children 5-6 years of age show understanding of and can sequentially follow through with three step directions.

Using the review of research and state and federal early learning standards, Ignite™ contains the following skill progression for the Listening and Understanding subdomain:

Skill Level	Skill Descriptor
1	Responds to one-step requests or questions
2	Carries out a one-step request that relates to a new or an unfamiliar activity or situation
3	Follows two-step, oral directions (that relate to familiar activity or situation
4	Carries out two-step requests that involve a new or unfamiliar activity or situation
5	Carries out multi-step requests that relate to familiar activities or situations
6	Attends to multiple details in directions

Vocabulary

Vocabulary is defined as "knowledge about the meanings, uses, and pronunciation of words" (U.S. Department of Education, 2016), which children often learn indirectly, through everyday experiences with oral and written language" (National Institute for Literacy, 2003). Rich language experiences allow for young children to acquire a greater understanding of vocabulary; however, these experiences alone do not aid in such acquisition. Children must be able to observe and utilize vocabulary in meaningful contexts and build upon their prior knowledge of words for true understanding to occur (Neuman, 2011). With experience and practice, children begin speaking in two words sentences, increasing in word length and complexity through enhanced vocabulary (Bloom, 1970). However, varying backgrounds and experiences with language play a role in children's vocabulary base. Newest research on vocabulary acquisition suggests that the more conversational exchanges a child has, regardless of socioeconomic background, determines their language and vocabulary skills (Romeo, et al., 2018). Aligning research with

state and federal early learning standards suggests that children develop vocabulary in the following progression:

- Children 2-3 years of age show understanding of the meaning of common words used in daily activities (I.e., descriptive words, words in familiar songs or stories, and body parts).
- Children 3-4 years of age show understanding of increasingly more descriptive (I.e., feelings, actions, things, familiar ideas) and opposite (I.e. up and down, hot and cold, wet and dry) words.
- Children 4-5 years of age show understanding of various and more specific words including functional and organizational vocabulary (I.e., same and different, in front of and behind, opposite, below). Children are also able to utilize subject-specific vocabulary related to topic of study (I.e., "larvae" when learning about life cycles).
- Children 5-6 years of age show understanding of new words and "with guidance and support from adults, exploring word relationships and nuances in word meanings" (NGSS, 2020).

Using the review of research and state and federal early learning standards, Ignite™ contains the following skill progression for the Vocabulary subdomain:

Skill Level	Skill Descriptor
1	Understands color words
2	Sorts words into categories
3	Demonstrates understanding of comparative adjectives
4	Demonstrates understanding of common antonyms
5	Demonstrates understanding of cross-curricular words

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Physical Development

Physical development encompasses more than just physical activity and motor skills - It involves children's holistic wellness. Children's holistic wellness includes overall well-being (physical, emotional, and mental), knowledge of the physical body (how it grows and develops), and healthy activities, practices, and habits (including safety, nutrition, and self-care practices) (Centers for Disease Control and Prevention, 2013; Donnelly, et al., 2016; Jones, Greenberg, & Crowley, 2015).

Young children are consistently expanding upon their knowledge of their physical health by understanding the reason for healthy behaviors and habits. With this knowledge, they develop personal agency of their physical health. They show the ability to make healthy choices and decisions for the benefit of themselves and of others. According to the World Health Organization, children need to learn and develop their skills and understandings around physical health and healthy behaviors through "skill practice that focuses on specific health behaviors or decisions and employs active, participatory teaching and learning experiences…rather than passive ones" (2003).

During this period of learning and development, young children's thinking around health and best practices is also becoming more nuanced, as they reflect upon their growing knowledge and understanding. They are making the connections that:

- Self-management/self-regulation is a part of self-care
- Safety includes being physically and emotionally safe
- The body's response to physical activity and various health habits practices and the body's composition and makeup (e.g., shortness of breath after running – lungs – respiration)
- Healthy behaviors maintain one's physical health, strengthen one's physical health, and are preventative care (Centers for Disease Control and Prevention, 2013; Donnelly, et al., 2016; Jones, Greenberg, & Crowley, 2015; Joint Committee on National Health Education Standards, 2007; SHAPE America 2009, 2012, 2013, 2014, 2015a, 2015b, 2016, 2018).

Given the review of relevant research related to young children's knowledge of their physical care and well-being, Ignite™ includes three subdomains within

the domain of Physical Development: Self-Care, Nutrition, and Health and Safety.

Self-Care

Children's sense of self and their awareness of their own agency develops as they learn to perform self-care tasks independently and encourage others to do the same. Personal self-care tasks are opportunities for children to experience and understand that they contribute to taking care of themselves and their bodies.

Children learn behaviors that positively influence their own health and physical development through self-care experiences and routines. Their growing independence in these experiences aides in developing an overall sense of self-efficacy, which can in turn influence their confidence in other contexts. This sense of personal responsibility transfers to children's understanding of social responsibility and being able to not only take care of oneself but take care of and help others (Donnelly, et al., 2016; Jones, Greenberg, & Crowley, 2015; SHAPE America, 2016, 2018).

Young children are first able to show awareness of self-care routines (I.e. handwashing) but may not understand their sequences. As children begin practicing these routines daily, they begin to understand and can identify the simple sequence of self-care routines and can identify the objects necessary to complete the routine (I.e. turn on the water, lather soap on hands, rinse hands off, get a towel). The sequencing concepts built through self-care routines transfer to other types of routines found throughout the day, as children gain understanding that there is a specific order and structure to many tasks and activities.

Aligning research with state and federal early learning standards suggests that children develop awareness and practice of self-care in the following progression:

- Children 2-3 years of age show awareness of different self-care routines and can complete simple routines with support
- Children 3-4 years of age show increased understanding and execution of simple sequences in self-care routines and can identify the items needed to complete the routines
- Children 4-5 years of age show greater understanding of and can independently execute more complex sequences in self-care routines
- Children 5-6 years of age are able to transfer the sequencing concepts of self-care routines to other daily routines

Using the review of research and state and federal early learning standards, Ignite™ contains the following skill progression for the Self-Care subdomain:

Skill Level	Skill Descriptor
1	Identifies self-care routines and scenarios
2	Identifies basic processes for self-care (hand washing, feeding, toileting)
3	Identifies objects needed for basic self-care activities
4	Identifies daily routine activities
5	Identifies steps in daily routine and self-care processes

Nutrition

Young children are constantly increasing their understanding of physical development by adopting simple self-care tasks and behaviors. One way that children learn about taking care of their physical bodies includes the practice of eating healthy and nutritious food. As children grow in their understanding of food and how it fuels the body, they begin the process of critically thinking about what types of food they should consume to maintain overall wellness. Children are also moving from distinguishing foods as simply healthy and unhealthy to categorizing and describing food in more complex ways (i.e., nutrient-rich/nutrient deficient; food to eat daily, food to not eat daily). They understand how different types of food contribute (or do not contribute) to one's health, and with this knowledge make informed choices and decisions (Centers for Disease Control and Prevention, 2013; SHAPE America, 2012, 2013, 2014, 2016, 2018).

Children need opportunities to not only learn the reasons for self-care and nutrition, but to demonstrate their skills and understandings and capabilities in making healthy food choices. Children's understandings and skills thrive when they take an active role in deciding and choosing meals. Additionally, they need opportunities to consider, reflect, and make these decisions in guided scenarios. These opportunities should be meaningful to the child's life at school and at home (SHAPE America, 2009, 2012).

According to the Head Start Early Learning Outcomes Framework, young preschoolers first show a basic understanding of the role of nutrition and food in healthy development. Then, they are able to show an increased understanding of why nutritious foods keep the body healthy. As children grow in their awareness and understanding of different types of healthy food, they can: think critically about food, identify healthy and unhealthy options, and understand the components of healthy meals (U.S. Department of Health and Human Services, 2015).

Aligning research with state and federal early learning standards suggests that children develop awareness and practice of nutrition in the following progression:

- Children 2-4 years of age show a basic understanding of healthy and unhealthy foods
- Children 4-6 years of age show more complex understandings about food and what it provides to the human body; can think critically about food and determine healthy components of a meal

Using the review of research and state and federal early learning standards, Ignite™ contains the following skill progression for the Self-Care subdomain:

Skill Level	Skill Descriptor
1	Identifies a variety of nutritious foods
2	Identifies healthy versus unhealthy foods
3	Creates a healthy breakfast menu
4	Creates healthy lunch and dinner menu
5	Creates a shopping list with healthy foods

Health and Safety

As young children develop knowledge around health and safety, they beginning to think more about how their own choices affect their well-being and the well-being of others. At this age, they begin showing the ability to reflect, consider, and respond to what they are experiencing in their environment. This active reflection on how one can be healthy and safe is vital for children as it allows them to take more personal responsibility for their role in creating and maintaining a safe environment.

When children have opportunities to consider options on healthy and safe activities, they further develop their ability to make safe choices in the future for their well-being as well as the well-being of others. This awareness of safe practice starts early on as young preschoolers first show awareness of safe practices, then can exhibit independence in these practices (U.S. Department of Health and Human Services, 2015). When children exhibit independence in carrying out healthy and safe choices, they are able to assist their peers in maintaining these safe practices.

Aligning research with state and federal early learning standards suggests that children develop awareness and practice of health and safety in the following progression:

- Children 2-3 years of age show a basic understanding of safety practices and routines
- Children 3-4 years of age show increased understanding of more safe and healthy practices

- Children 4-6 years of age demonstrate understanding and independence in safe and healthy practices, and help their peers maintain health and safety as well

Using the review of research and state and federal early learning standards, Ignite™ contains the following skill progression for the Health and Safety subdomain:

Skill Level	Skill Descriptor
1	Demonstrates understanding of personal safety practices and routines
2	Identifies ways to play safely
3	Identifies behaviors that promote health and safety
4	Applies knowledge and skills related to health promotion, disease prevention, and health maintenance
5	Identifies, avoids, and alerts others to danger

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Mathematics

Children in early childhood are constantly developing mathematical knowledge through contextual, day-to-day experiences. This exposure to mathematical learning naturally develops children's ability to become "mathematical thinkers and problem solvers" (NCTM, 2013). The subdomains within Mathematics require a great deal of cognitive functioning as children practice generalizing and thinking abstractly. In the Head Start Early Learning Framework, math knowledge and understanding are categorized and placed under the "Cognitive" domain (U.S. Department of Health and Human Services, 2015). Both Common Core State Standards for Mathematics and NCTM's Principles and Standards for School Mathematics contain math standards with two overarching categories: the process/the practice of math and content (NCTM, 2000; NGSS, 2010).

Very young children begin developing their understanding of mathematical knowledge with concrete representations in everyday experiences. Skills such as number sense (i.e. numbers representing quantity), simple classification (using one attribute to group objects), spatial relationships (manipulating objects to fit and move in space), and simple patterns (daily schedules and routines) are developed as children interact with objects and people in many environments. Through these experiences, children learn that there is structure and order to their world, and can use this learning to create meaningful connections when they are ready to develop more abstract mathematical understandings.

The Common Core State Standards for Mathematics contains eight mathematical practices to accompany and complement content areas of mathematics. As young children learn the content and the skills associated with counting and cardinality; operations and algebraic thinking; number and operations; measurement and data; and geometry, students are also learning (and understanding) how to:

- Make sense of problems and persevere in solving them.
- Reason abstractly and quantitatively.
- Construct viable arguments and critique the reasoning of others.
- Model with mathematics.
- Use appropriate tools strategically.
- Attend to precision.
- Look for and make use of structure.
- Look for and express regularity in repeated reasoning. (2010)

The breadth of skills within mathematics is quite wide. Given the large number of subdomains that are important to mathematics development as well as the review of federal and state early learning guidelines, the subdomains within Mathematics are organized into four strands: Counting and Cardinality, Operations and Algebraic Thinking, Math Applications, and Geometry.

Counting and Cardinality

Counting and cardinality involves children's "deep and fundamental understanding of, and proficiency with, counting, numbers, and arithmetic, as well as an understanding of number systems and their structures" (NCTM, 2010). These skills and understandings are heavily connected and intertwined with children's operational & algebraic thinking and understanding of number and operations in base ten.

> *Young children should attain a rich understanding of numbers—what they are; how they are represented with objects, numerals, or on number lines; how they are related to one another; how numbers are embedded in systems that have structures and properties; and how to use numbers and operations to solve problems" (NCTM, 2010).*

Counting "enables children to determine the quantity of any set by using number words to mark each item in a set." It includes children's understanding of number words and sequence; one-to-one correspondence; and cardinality and ordinality of sets of objects. Cardinality refers to the understanding that "the last number word said when counting tells how many objects have been counted" (Education Development Center, 2016).

Given the review of relevant research related to young children's development of number concepts, Ignite™ includes the subdomains within Counting and Cardinality: Number Sequencing, Set Counting, Subitizing, Comparing Quantities, and Ordinal Numbers.

Number Sequencing

Numeral recognition is "the ability to identify and name basic numerals" and involves several "core mathematical skills such as matching numbers to quantity, identifying numbers, and naming numbers" (NCTM Interactive Institute, 2015). Children's numeral recognition ensures the ability to count successfully and meaningfully while understanding the number sequence ("names and the ordered lists of number words" and one-to- one correspondence ("identifying and saying number words in correspondence with the objects counted") (NCTM Interactive Institute, 2015; NSF & EDC, 2015).

Children's first experiences with number sequencing come with rote counting and comparing small groups of quantities. As children begin to make the connection between number names, numerals, and quantities, they are then able to demonstrate abstract understanding of the number sequence. This understanding involves the ability to conceptualize numbers that come before or after a certain number, then advancing to sequencing forwards and backwards.

Aligning research with state and federal early learning standards suggests that children develop number sequencing in the following progression:

- Children 2-3 years of age show emerging understandings of number sequencing through counting sets of objects in a group of up to 3; children show emerging understanding that number words are used separately from each other, however, may omit or combine number words in their sequencing
- Children 3-4 years of age begin to show understanding of number words in a sequence up to 10; children show emerging understanding that number words are used separately from each other
- Children 4-5 years of age show increased understanding of the number sequence 0-10; children are also able to understand that number words are used separately from each other; children understand that numbers can come before or after other numbers
- Children 5-6 years of age show understanding of the pattern of counting and can start counting anywhere on the number line backwards or forwards.

Using the review of research and state and federal early learning standards, Ignite™ contains the following skill progression for the Number Sequencing subdomain

Skill Level	Skill Descriptor
1	N/A
2	Orders quantities 0-5
3	Recognizes numerals 0 to 5
4	Recognizes numerals 0 to 10
5	Identifies the number that comes before or after a number between 0-10
6	Orders numerals 0-10 forward and backward

Set Counting

Set counting is "the ability to count to determine the number of objects in a set" (National Governors Association Center for Best Practices & Council of Chief State School Officers, 2010, quoted in NSF & EDC, 2015). Children's set

counting skills and understanding informs their "ability to perceive, describe, and reason about exact quantities" and cardinality, which is that the "last number in the counting sequence represents the quantity of the set (Clements & Sarama, 2014, quoted in NSF & EDC, 2015). Sequence, order, one-to-one correspondence, cardinality, and ordinality are all necessary components to set counting (NCTM, 2010). One-to-one correspondence in set counting involves the touching and/or moving of one object to another location when counting (Clements, 2014).

Very young preschoolers typically have practice counting with small sets of objects (up to 5), using emerging understandings of ordinality, cardinality, and one-to-one correspondence. Children at this age may need support in counting. Young preschoolers are able to perceive what whole numbers are as they count objects in small groups (of up to 5) and can connect counting with cardinality. As children refine their understanding of how number words connect to number quantity, they will begin to independently use one-to-one correspondence in counting a group of up to 10 objects and connecting their counting with cardinality. By kindergarten, children will count a group of 10 – 20 objects independently using one-to-one correspondence, accurately identifying the number of objects in the group. They can count to answer 'how many?" questions about as many as 20 objects arranged in a line, a rectangular array, or a circle, or as many as 10 things in a scattered configuration. Additionally, late preschool and kindergarten students understand that objects may be combined or separated to form groups (up to 5 objects). Aligning research with state and federal early learning standards suggests that children develop set counting in the following progression:

- Children 2-3 years of age show emerging understandings of counting small groups of objects (up to 5) with assistance
- Children 3-4 years of age show understanding of counting groups of up to 10 objects in an organized arrangement.
- Children 4-5 years of age show increased understanding of counting to 10 objects, and are able to produce, combine, or separate groups of up to 5.
- Children 5-6 years of age show understanding of counting as many as 20 objects in an organized arrangement, and 10 objects in scattered arrangements.

Using the review of research and state and federal early learning standards, Ignite™ contains the following skill progression for the Set Counting subdomain:

Skill Level	Skill Descriptor
1	Touches one object for each number said for sets of up to 5 objects
2	Counts up to 5 objects

3	Counts up to 10 objects
4	Produces sets of up to 5 objects
5	Produces sets of up to 10 objects
6	Counts sets of up to 20 objects

Subitizing

Subitizing is the ability to instantly see "how many" in a group. It is "visually recognize the number of items in a small set without counting," a "perceptual process that allows for the instant recognition of the quantity of small sets" (Clements, 1999 quoted in Educational Development Center, 2016; NCTM Interactive Institute, 2015). This is also referred to as *perceptual subitizing*. Subitizing is a "crucial early skill… [that] strengthens students' ability to efficiently and flexibly determine how many when working with larger sets and supports work with composing and decomposing quantities… and support work with composing and decomposing quantities;" and "is a precursor to place value" (NCDPI, 2019a, 2019b).

Conceptual subitizing is a "more advanced skill that follows children's perceptual subitizing"; it is the ability to recognize numbers in smaller groups and add them together (Clements, 1999; Clements, Sarama, & MacDonald, 2019). The ability to subitize is critically important for children's mathematical thinking and understanding for several reasons. "It saves time, it is a forerunner of some powerful number ideas, it helps develop more sophisticated counting skills, and it accelerates the development of addition and subtraction." (Reys, Lindquist, Lambdin, & Smith, 2006, quoted in NCTM Interactive Institute, 2015). The arrangement of objects in a collection are important, as children are initially successful with linear collections, then rectangular arrangements (objects organized in two lines), and finally scattered arrangements (Clements, 2014).

Aligning research with state and federal early learning standards suggests that children develop subitizing skills in the following progression:

- Children 2-3 years of age can differentiate between groups of one and more than one
- Children 3-4 years of age can differentiate groups of two or three
- Children 4-5 years of age are able to recognize groups of up to four, initially in organized arrangements, then moving to scattered arrangements.
- Children 5-6 years of age can recognize groups of up to five initially in organized arrangements, then moving to scattered arrangements

Using the review of research and state and federal early learning standards, Ignite™ contains the following skill progression for the Subitizing subdomain:

Skill Level	Skill Descriptor
1	N/A
2	N/A
3	Instantly recognizes collections up to 4 in typical arrangements (perceptual subitizing)
4	Instantly recognizes collections up to 4 in random arrangements (perceptual subitizing)
5	Instantly recognizes collections up to 5 (perceptual subitizing)
6	Instantly recognizes collections up to 5 when collections contain two colors (conceptual subitizing)

Comparing Quantities

Comparing quantities is a crucial part of children's development of number sense and involves what NCTM categorizes as two big ideas:

1. Number is an extension of more basic ideas about relationships between quantities.
2. The selection of a unit makes it possible to use numbers in comparing quantities. (NCTM, 2010; NCTM, 2015).

Comparisons of quantities (i.e., "length, area, discrete quantities" [NCTM, 2010]) further children's understanding of one-to-one correspondence and ensure children's awareness of "relationships such as more than, less (fewer) than and as many" (Reys, Lindquist, Lambdin, & Smith, 2006, quoted in NCTM, 2015). Children begin the comparison of sets of objects from a very young age, but are not yet capable of independently counting to make comparisons (Clements, 2014). Clements (2014) states that children should have opportunities to practice the skill of subitizing to build mental pictures of what numbers and collections look like before they are able to compare quantities. Only by the age of four are children able to answer questions that compare (I.e. "which number is more?) (Clements, 2014). Beginning in kindergarten, children are able to understand that each successive number name refers to a quantity that is one larger. They can also identify whether the number of objects in one group is greater than, less than, or equal to the number of objects in another group, e.g., by using matching and counting strategies. Finally, children in kindergarten are able to compare two numbers between 1 and 10 presented as written numerals.

Aligning research with state and federal early learning standards suggests that children develop the ability to compare quantities in the following progression:

- Children 2-4 years of age begin forming foundational understandings of quantities through supported production of a group of objects.

- Children 4-5 years of age are able to compare quantities and begin identifying sets of objects that are larger and smaller.
- Children 5-6 years of age show understanding of comparing numbers of objects in a group of up to 10; children can use strategies to compare such as counting and pairing objects

Using the review of research and state and federal early learning standards, Ignite™ contains the following skill progression for the Comparing Quantities subdomain:

Skill Level	Skill Descriptor
1	Places objects into a set structure that forces one-to-one correspondence
2	Pairs objects using on-to-one correspondence
3	Correctly chooses the set of objects that has more or less when shown two sets that varygreatly in size
4	Counts sets of up to 5 to compare
5	Counts sets of up to 10 to compare when objects are the same or different sizes
6	Determines "how many" more are in the larger set when provided sets with up to 10

Ordinal Numbers

Counting includes cardinality and ordinality of sets of objects. In Principles and Standards, NCTM affirms that "meaningful counting integrates different aspects of number and sets, such as sequence, order, one-to-one correspondence, ordinality, and cardinality" (2010).

Cardinality "answers the question: how many?" (Lyons & Beilock, 2013). Ordinality answers the question: what order/position? (i.e, first, second, third, etc.)" (NCTM, 2000; White & Knighten, 2016). Cardinality and ordinality are considered two aspects, two properties of numerical concepts (Brannon & Van de Walle, 2001; Lyons & Beilock, 2013).

In the research around "symbolic and non-symbolic number representations…" the focus is "almost exclusively on cardinality" (Lyons & Beilock, 2013) and this is reflected in the Common Core State Standards for Mathematics (2010) and in NCTM's Principles and Standards for School Mathematics (2000).

NCTM addresses ordinality in the content standard, "Understand numbers, ways of representing numbers, relationships among numbers, and number systems" detailing the PreK – 2 Expectations as to "develop understanding of the relative position and magnitude of whole numbers and of ordinal and cardinal numbers and their connections" (2010). Children initially develop the

words involving “first”, "second”, and “last” early, and develop all other ordinal numbers later on (Clements, 2014).

Ordinality is not explicitly addressed in the CCSS for math. Some state standards that have adopted CCSS have added additional language and clarification to address ordinality. For example, New York has added “Develop understanding of ordinal numbers (first through tenth) to describe the relative position and magnitude of whole numbers” for “Counting & Cardinality – Count to tell the number of objects” for kindergarten (New York State Education Department, 2017).

Using the review of research and state and federal early learning standards, Ignite™ contains the following skill progression for the Ordinal Numbers subdomain:

Skill Level	Skill Descriptor
1	Identifies the “first” object arranged in a line
2	Identifies the “last” object arranged in a line
3	Identifies the “first” and “second” object arranged in a line
4	Identifies the position of the first, second, and last object arranged in a line
5	Arranges up to four objects using knowledge of ordinal positions
6	Identifies ordinal numbers "first" through "fifth"

Operations and Algebraic Thinking

Young children’s operational and algebraic thinking is about understanding and using numbers. The areas of focus for young children in operations and algebraic thinking include patterns, relationships, and functions; understandings of addition and subtraction, and meanings of operations and how they relate to one another (NCTM, 2000, 2010; NGSS, 2010).

Early experiences with the joining and separating of sets provides a solid foundation for later understanding and manipulation with numbers in algebraic procedures (Caldwell et al., 2011). Additionally, early experiences with manipulating sets reflects a strong connection between algebraic thinking and number and operations, as children “engage in real-world mathematical problems, they conceive of quantities, numbers with associated units” (Colorado Department of Education, 2020a; NCTM, 2010).

According to the Head Start Early Learning Outcomes Framework, young children initially develop their operational and algebraic thinking through simple opportunities to add, subtract, or arrange small groups of objects in a pattern (U.S. Department of Health and Human Services, 2015). As children develop greater understanding of these mathematical practices, they are more able to compose and decompose larger groups of objects and identify and produce more complex patterns.

Children's meaningful engagement with operational and algebraic thinking leads to children's fluency in operational and algebraic thinking:

> *Fluency is developed by understanding and internalizing the relationships that exist between and among numbers. … Students are fluent when they display accuracy (correct answer), efficiency (a reasonable number of steps in about 3-5 seconds without resorting to counting), and flexibility (using strategies such as the commutative property). (NCPDI, 2019a, 2019b).*

Given the review of relevant research related to young children's development of skills related to mathematical operations, Ignite™ includes two subdomains within Operations and Algebraic Thinking: Patterns, Addition, and Subtraction.

Patterns

According to Clements (2014), "patterning is the search for mathematical regularities and structures" (p.215). In NCTM's mathematical standards, the preschool through second grade expectations for children's learning about patterns (as part of operational and algebraic thinking) includes developing the knowledge of and ability to:

- Sort, classify, and order objects by size, number, and other properties
- Recognize, describe, and extend patterns such as sequences of sounds and shapes or simple numeric patterns and translate from one representation to another
- Analyze how both repeating and growing patterns are generated
- Understand patterns, relations, and functions (2000).

Clements' (2014) Learning Trajectories for Patterns and Structure suggests that, children initially begin identifying patterns within song and dance, but may not be able to identify linear patterns. Using the foundation of pattern understanding through music and movement, children are then able to recognize simple ABAB patterns (I.e. circle, square, circle, square). By age four, children are able to fill in or duplicate an ABAB pattern, as well as identify other simple patterns such as AABB or ABCABC. Children then begin to extend simple patterns by early kindergarten, increasing their ability to extend and create as they develop.

Aligning research with state and federal early learning standards suggests that children develop skills with patterns in the following progression:

- Children 2-3 years of age begin forming foundational understandings of patterns through music and movement with support.

- Children 3-4 years of age show understanding of filling in and duplicating simple patterns
- Children 4-5 years of age show increased understanding of filling in and duplicating patterns and can identify multiple various simple patterns
- Children 5-6 years of age show understanding of extending and generating patterns independently

Using the review of research and state and federal early learning standards, Ignite™ contains the following skill progression for the Patterns subdomain:

Skill Level	Skill Descriptor
1	Copies ABAB patterns
2	Fills in and extends ABAB patterns
3	Creates simple repeating patterns
4	Copies AABBAA, ABCABC, and ABBABB patterns
5	Extends and fills in missing parts of AABBAA, ABCABC, and ABBABB patterns
6	Creates varied repeating patterns

Addition and Subtraction

Addition and subtraction are strategies of arithmetic, or the manipulation of numbers. Children as young as three years of age can begin developing understandings in arithmetic, while four-year-old children are able to solve arithmetic problems with accuracy (Clements, 2014). The expectations for early elementary students' addition and subtraction learning is "part of a progression involving addition and subtraction of increasingly large numbers and increasingly complex problem subtypes" (Colorado Department of Education, 2020a).

Preschool and early elementary aged children's addition and subtraction learning involve their ability to: a) Understand addition as composing (putting together and adding to) and subtraction as decomposing (taking apart and taking from) and the effects of adding and subtracting whole numbers, (b) Understand and apply properties of operations and the relationship between addition and subtraction, (c) Represent and solve problems involving addition and subtraction and model situations that involve the addition and subtraction of whole numbers, using objects, pictures, and symbols (i.e., a variety of methods and tools to compute), (d) Work with addition and subtraction equations, and (e) Develop fluency with basic number combinations for addition and subtraction (NCTM, 2000; NGSS, 2010).

Young children's representations when adding and subtracting also refine their understanding of and fluency with addition and subtraction, as they

"(move) beyond rote counting and into being able to solve these problems mentally. Students should be able to explain their reasoning using manipulatives, pictures, numbers, or words" (NCPDI, 2019a, 2019b).

Aligning research with state and federal early learning standards suggests that children develop skills with addition and subtraction in the following progression:

- Children 2-3 years of age begin to nonverbally add and subtract small collections
- Children 3-4 years of age show understanding of solving addition and subtraction problems with groups of up to 5 objects
- Children 4-5 years of age show understanding of solving addition and subtraction problems with groups of up to 8 objects; children can count on from any number between 1-10; can find missing addend
- Children 5-6 years of age show understanding of solving addition and subtraction problems with groups of up to 10 objects; children may find sums or totals by counting on or using fingers (Clements, 2014)

Using the review of research and state and federal early learning standards, Ignite™ contains the following skill progression for the Addition and Subtraction subdomains:

Addition

Skill Level	Skill Descriptor
1	Finds the total by joining groups and counting all the objects in situations where the sum is 4 or less
2	Identifies how two small groups can be composed to create a larger group of 5 or fewer objects
3	Finds the total when given a word problem or scenario by directly modeling the problem with objects and counting all the objects when the sum is 6 or less
4	Finds the total when given a word problem or scenario by directly modeling the problem with objects and counting all the objects when the sum is 8 or less
5	Finds the total by counting on from the first addend with sums up to 10
6	Given a set of objects, adds on to the set to make a given total

Subtraction

Skill Level	Skill Descriptor
1	Finds the difference by separating objects
2	Decomposes 5 or fewer objects into two groups

3	Finds the difference when given a word problem or scenario by directly modeling the problemwith objects and taking away some objects when the whole is 6 or less
4	Finds the difference when given a word problem or scenario by directly modeling the problemwith objects and taking away some objects when the whole is 8 or less
5	Finds the difference by counting backwards with a whole up to 10
6	Given a set of objects, takes away from the set to make a given total

Math Applications

Children begin intuitively developing math applications from an early age. From a young age, children frequently and subconsciously compare and make inferences about objects and people based on attributes. Additionally, they group these objects based upon their known characteristics. It is in familiar act of assimilating and accommodating information that children begin to develop foundational cognitive skills that involve measurement and classification. Math applications like measurement (and comparison), classification, and data collection are skills that help children make sense of their environment. For this reason, these math applications also contribute greatly to children's scientific thinking and reasoning. Early childhood math application skills also work in tandem with developing geometry, counting and cardinality, and addition and subtraction skills.

For NCTM, preschool and early elementary expectations for children's math applications knowledge and understanding include children's ability to:

- recognize the attributes of length, volume, weight, area, and time
- apply appropriate techniques, tools, and formulas to determine measurements
- compare and order objects according to these attributes
- understand how to measure using nonstandard and standard units
- select an appropriate unit and tool for the attribute being measured
- measure with multiple copies of units of the same size, such as paper clips laid end to end
- use repetition of a single unit to measure something larger than the unit, for instance, measuring the length of a room with a single meter stick
- use tools to measure
- develop common referents for measures to make comparisons and estimates
- pose questions and gather data about themselves and their surroundings
- sort and classify objects according to their attributes and organize data about the objects
- represent data using concrete objects, pictures, and graphs describe parts of the data and the set of data as a whole to determine what the data show
- discuss events related to students' experiences as likely or unlikely

The Head Start Early Learning Outcomes Framework suggests that young preschool children can be supported in their skills of measurement through discussion of comparing and contrasting attributes (U.S. Department of Health and Human Services, 2015). These discussions give children an important vocabulary base that will allow them to more independently and consciously apply math applications in everyday life. According to the Colorado Department of Education (2020a), preschool children show capabilities in gathering, displaying, summarizing, examining, and interpreting data to discover patterns and deviations from patterns.

Given the review of relevant research related to young children's application of mathematical skills to make sense of the world around Ignite™ includes two subdomains within Math Applications: Measurement and Classification and Data.

Measurement

According to NCTM (2020), measurement involves understanding measurable attributes of objects and the units, systems, and processes of measurement. Additionally, it involves applying appropriate techniques, tools, and formulas to determine measurements.

According to Clements and Samara (2014), measurement requires two very important mental functions; the ability to identify and subdivide the unit of measurement, and the ability to iterate (line up end to end) objects. Clements and Samara (2014) also suggested a developmental progression for measurement, beginning with very young children's intuitive ability to order the length of objects. Young preschoolers then begin to identify length as an attribute of an object and will use comparison vocabulary to determine which objects are longer or taller. Children later develop the ability to physically line objects up at their endpoints to first directly compare length, and then indirectly compare length using another object to measure. As preschoolers refine their ability to measure, they develop understanding that length can be connected to a number through standard measurement. Finally, children developing length-unit iteration, or the ability recognize that units should not have space between them when they are measured.

Aligning research with state and federal early learning standards suggests that children develop skills with patterns in the following progression:

- Children 2-3 years of age are able to intuitively order objects by height or length
- Children 3-4 years of age are able to recognize height and length as an attribute, and can identify the object that is taller and/or longer

- Children 4-5 years of age are able to demonstrate greater understanding of ordering and comparing; children at this age understand the correlation between length and number of units
- Children 5-6 years of age are able to are able to independently align objects to compare directly or indirectly with the use of another object

Using the review of research and state and federal early learning standards, Ignite™ contains the following skill progression for the Measurement subdomain:

Skill Level	Skill Descriptor
1	Orders up to 3 objects by length and height
2	Identifies the object that is longer, taller, or shorter
3	Builds towers that are either shorter or taller than an object
4	Fills in containers with cubes to compare volumes
5	Orders up to 10 objects by length and height
6	Indirectly compares the length of two objects by using a third object

Classification and Data

Classification is an innate skill that all young children have from birth. The ability to classify involves the following of a given rule based on the characteristics of objects (I.e., color, size, shape). The ability to classify objects is an important cognitive skill that young children develop that lends itself to greater mathematic and scientific thinking. According to the Head Start Early Learning Outcomes Framework, young children are able to identify objects based on simple attributes (I.e., color or size) (U.S. Department of Health and Human Services, 2015). As children further develop their classification skills, they can sort objects into groups based on one or more complex attributes (I.e. weight or texture). Children in kindergarten have refined classification skills. They consistently sort and reclassify objects based upon other attributes and can interpret and create simple picture graphs (Clements, 2014).

Aligning research with state and federal early learning standards suggests that children develop skills with patterns in the following progression:

- Children 2-3 years of age are able to identify objects based on one characteristic (I.e., color or size)
- Children 3-4 years of age deepen their understanding of classification by identifying and sorting objects based on one characteristic, and may begin showing signs of identifying more than one attribute in an object
- Children 4-5 years of age are able to identify and sort objects based on one or more complex attributes

- Children 5-6 years of age show understanding of interpreting and begin creating simple picture graphs

Using the review of research and state and federal early learning standards, Ignite™ contains the following skill progression for the Classification and Data subdomain:

Skill Level	Skill Descriptor
1	Identifies objects given a single attribute
2	Sorts objects based on a single attribute
3	Matches similar objects
4	Identifies objects given two attributes
5	Sorts objects based on two attributes
6	Interprets simple picture graphs

Geometry

Geometry is the study of "geometric shapes and structures and how to analyze their characteristics and relationships." The foundation for children's geometry development is their understandings of spatial relationships, shapes, and spatial visualization (NCTM, 2000). Children's study of geometry "allows them to comprehend space and shape," as they begin to "analyze the characteristics and relationships of shapes and structures and engage in logical reasoning" (Colorado Department of Education, 2020a).

These beginning understandings of spatial relationships, of shapes and how shapes can be manipulated, composed, and decomposed build and strengthen early elementary students' spatial thinking, including the development of spatial-numeric connections. These beginning understandings in kindergarten, first, and second grade are essential to children's later learning and understandings around measurement, geometric problems, fractions, and multiplication. Children's geometric understandings are also critical for higher-level thinking in all areas of learning and in real-life situations such as problem-solving, representing, for reasoning, and justifying hypotheses and proofs (NCTM, 2000).

Given the review of relevant research related to young children's development of geometrical concepts, Ignite™ includes two subdomains within Geometry: Spatial Relationships and 2-D Shapes.

Spatial Relationships

Spatial relationships involve spatial awareness ("how objects are oriented in relation to one another"). These types of relationships are the foundation for spatial visualization or "building and the manipulation of mental representations of two- and three-dimensional objects and perceiving an object from different perspectives" (Clements, 2004; NCTM, 2000). Children's

understanding of spatial relationships is also essential for their later "spatial reasoning" as they "interpret and describe physical environments" (NCTM, 2000). Children develop their spatial awareness and understandings by first becoming aware of and then exploring the relationship between their physical body and the physical environment around them.

Young children develop a language of space early on, often using spatial language more frequently than object names (Clements & Samara, 2014). children develop understanding about how objects move and fit in space, using words to describe size and location (Colorado Department of Education, 2020b). According to Clements and Samara (2014), young children develop understanding of words related to position (I.e. in, on, under, up, and down) when object transformation from one space to the other. Then, children begin to understand the words "between" and "beside". By kindergarten, children are able to acquire more complex positional vocabulary (over, under, above, under, near, far, next to/beside) and use positional words correctly. Words such as "left" and "right" are challenging for children and typically do not develop by first or second grade; however, early exposure to these words is helpful in the preschool years (Clements & Samara, 2014).

Aligning research with state and federal early learning standards suggests that children develop skills in spatial relationships in the following progression:

- Children 2-3 years of age are able to comprehend positional words "in", "on", "under"
- Children 3-4 years of age are able to comprehend vertical directionality words "up" and "down"
- Children 4-5 years of age are able to comprehend proximity words "beside" and "between"
- Children 5-6 years of age are able to develop deeper understanding of and accurately use position words that relate to distance, position, and direction, as well as the introduction to "left" and "right"

Using the review of research and state and federal early learning standards, Ignite™ contains the following skill progression for the Spatial Awareness subdomain:

Skill Level	Skill Descriptor
1	Follows simple directions related to position (in, on, off, over, and under)
2	Follows simple directions related to direction (up and down)
3	Follows simple directions related to proximity (besides, between, next to)
4	Follows simple directions related to frames of reference (behind, left, right, in front of, to thisside of, above, below)

5	Appropriately responds to positional words indicating position, direction, and distance

2-D Shapes

The concept of shape is foundational to young learners' cognitive development. According to Clements and Sarama (2014), very young preschool children construct their own knowledge of shapes through shapes in their environment, but often are not yet able to identify the attributes of a shape. As they experiment with shapes in their environment, they use their prior knowledge of environmental shapes to inform what whole shapes are. Around three years of age, children are more likely to identify simple whole shapes (i.e. circle, square, triangle) as well as construct them (Clements & Sarama, 2014). Children in late preschool and early kindergarten have the ability to name shapes based on their unique attributes regardless of orientation or size (U.S. Department of Health and Human Services, 2015).

Aligning research with state and federal early learning standards suggests that children develop 2-D shape awareness in the following progression:

- Children 2-3 years of age show understanding of how shapes relate to other shapes in the environment.
- Children 3-4 years of age show understanding of whole shapes and their names; children can match shapes with both similar and varied sizes and orientations
- Children 4-5 years of age show increased understanding of more shapes (i.e. trapezoid, rhombus, parallelogram, hexagon); children have the ability to manipulate and construct shapes to match another shape
- Children 5-6 years of age show greater understanding of the attributes of shapes, describing angles, sides, and typical "rules" that shapes follow

Using the review of research and state and federal early learning standards, Ignite™ contains the following skill progression for the 2-D Shapes subdomain:

Skill Level	Skill Descriptor
1	Matches 2 identical simple shapes (square, triangle, circle) that have the same size and orientation
2	Matches 2 identical simple shapes (square, triangle, circle) that have different sizes and orientations
3	Names a circle, square, and triangle when shown a prototypical shape (e.g., an equilateral triangle, a square rotated 45 degrees, or an elongated rectangle

4	Completes a pattern block puzzle by choosing the correct shapes to fit in each piece
5	Identifies what 2-dimensional shapes create the faces of 3-dimensional objects
6	Describes attributes of basic 2-dimensional shapes

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Literacy

Literacy is one of the most fundamental determinants of a child's trajectory of success in the classroom and in life. The skills that help determine literacy learning include oral language, alphabetic code, and print knowledge and concepts (Texas Education Agency, 2015). Children develop literacy skills through meaningful engagement with words, books, and conversations with others. Bear et al. (2020) stated that literacy is like a braid, with the intertwining strands being reading, writing, orthography, oral language, vocabulary, and stories.

The renewed and heightened focus on children's literacy development in the context of the demands of the 21st century world has greatly influenced national and state-level curriculum standards. The underlying drive for the expectations and considerations for literacy development is ensuring children are career and college-ready, and that they are prepared and able to engage in critical reading and engagement and dialogue with a vast array of text and information (digital, written, and auditory) (NGSS, 2010; CA Dept. of Ed., 2013; CO Dept. of Ed., 2020a; Florida Dept. of Ed, 2020; NCDPI, 2017a; OR Dept. of Ed., 2019a, 2019b).

Literacy development is comprised a wide breadth of interconnected skills. Given the large number of subdomains that are important to literacy development, the subdomains within Literacy are organized into five strands: Phonological Awareness, Phonics, Reading, Listening Comprehension, and Writing

Phonological Awareness

The high-level, critical reading of later schooling begins with the development of young children's emergent reading skills. In the introduction to the Colorado Academic Standards for Reading, Writing and Communicating this foundational connection is made explicit:

> *"Phonemic awareness, phonics, fluency, and vocabulary" are the "foundational skills to establish the strong foundation for proficient readers. Ultimately, the end goal is for readers to be able to comprehend texts of varying levels of complexity, and in later grades, in all content areas" (2020a).*

Children's phonological awareness and understanding is a key part of their foundational reading skills as they "develop awareness of segments of sounds" and learn to "decode words and analyze word parts" (Colorado Department of Education, 2020a). Children's work with the phonemes (the smallest units of sound) in words includes blending (combining) phonemes (sounds) to form

words and segmenting (breaking) words into phonemes (sounds). When children are blending and segmenting phonemes, they are demonstrating phonemic awareness, (recognizing, identifying, and manipulating individual sounds in words.) Phonemic awareness is a subcategory of phonological awareness (National Institute for Literacy, 2003).

Phonological awareness is crucial for children's literacy development and contributes to later success in reading. In national and state standards, the focus is on phonological awareness as a reading foundational skill, for it is "especially important at the earliest stages of reading development – in preschool, kindergarten, and first grade for typical readers" (Moats & Tolman, 2009; Sesenbaugh, 1996)

Phonological awareness has a broad focus: "identifying and manipulating larger parts of spoken language" and "encompasses awareness of other aspects of sound" with "a continuum of skills that develop over time" from basic levels of awareness of speech sounds (e.g., alliteration and rhyming) to advanced levels of awareness of speech sounds (e.g., phonemic awareness).

Given the review of relevant research related to young children's development of phonological awareness, Ignite™ includes four subdomains within Phonological Awareness: Blending, Segmenting, Rhyming, and Alliteration.

Blending

Blending is combining phonemes to form words, and "is a way for students to decode words. With phonics blending, students fluently join the individual sound-spellings (also called letter–sound correspondence) in a word" (Johnson, 2020). Blending is also referred to as: phoneme blending, phonics blending, visual blending, synthetic phonics, or sounding out.

As children begin learning to blend by first focusing on the individual sounds of each word, starting with the sound-spellings of one-syllable words, and moving onto longer words. They blend words by combining syllables and *onsets* (the initial phonological unit of a word) and *rimes* (the letters that follow the onset).

Phoneme blending learning involves children listening to a sequence of separately spoken phonemes, recognizing, and identifying the phonemes, then combining the phonemes to form a word. Teachers then write out the sounds and read the blended word. Ultimately children willbe able to not only blend a word but write and read the word on their own.

Blending builds students' literacy development and development by supporting students' ability to read unfamiliar words and gives them the understanding and awareness of a "consistent strategy for approaching new words. They are focusing on each sound to recognize and identify it. Students who have been taught this strategy are more likely to read words correctly,

which isespecially motivating for students who struggle with reading" (Johnson, 2020; National Institutefor Literacy, 2003).

Aligning research with state and federal early learning standards suggests that children develop blending skills in the following progression:

- Children 2-3 years of age can demonstrate awareness of syllables in words
- Children 3-4 years of age can demonstrate the combining of two words to create a compound word
- Children 4-5 years of age are able to blend the onset and the rime of a one-syllable word; children can blend spoken phonemes in a one-syllable word with pictorial support
- Children 5-6 years of age are able to blend the initial, medial, and final sounds in CVC words together

Using the review of research and state and federal early learning standards, Ignite™ contains the following skill progression for the Blending subdomain:

Skill Level	Skill Descriptor
1	Combines two words to make a compound word
2	Add missing word to form a compound word
3	Combines syllables to form words
4	Blends onsets and rimes to make one-syllable words
5	Blends phonemes to form simple words
6	Blend phonemes to form simple words quickly

Segmenting

Segmenting is breaking words into sounds or taking a word apart by its individual sounds. Children first begin segmenting gaining an awareness of oral word boundaries. This is followed by breaking simple words larger words into chunks of sound (i.e. syllables or words within compound words); they then move to breaking simple and more complex words apart by into onsets (the initial phonological unit of a word) and rimes (the letters that follow the onset). Segmenting is also referred to as phoneme segmentation. Lastly, the are able to break words into discrete phonemes.

Learning to segment words is a critical skill for children's spelling. As children segment words, they are experiencing and "understand(ing) that sounds and letters are related in a predictable way. Thus, they can relate the sounds to letters as they spell words" (Johnson, 2020; National Institute for Literacy, 2003).

Learning to segment involves children breaking a word into its individual sounds and saying each sound. Teachers then write out the sounds and read

the segmented word. Ultimately children will be able to not only segment a word but write and read the word on their own.

Aligning research with state and federal early learning standards suggests that children develop segmenting skills in the following progression:

- Children 2-3 years of age can demonstrate awareness of individual words in simple sentences
- Children 3-4 years of age can demonstrate the separation of a compound word to create two individual words
- Children 4-5 years of age are able to segment spoken words into syllables; children can segment the onset and rime of a single syllable spoken word
- Children 5-6 years of age are able to isolate the initial, medial, and final sounds in CVC words

Using the review of research and state and federal early learning standards, Ignite™ contains the following skill progression for the Segmenting subdomain:

Skill Level	Skill Descriptor
1	Identifies separate words within a sentence
2	Segments compound words into two words
3	Deletes word from a compound word
4	Segments words into syllables
5	Explores segmenting simple words into individual phonemes
6	Isolates final sounds in CVC words

Rhyming

The ability to hear rhyming words is one of the earliest components of phonological awareness that a child develops. Phonological awareness is crucial for children's literacy development and contributes to later success in reading. In national and state standards, the focus is on phonological awareness as a reading foundational skill, for it is "especially important at the earliest stages of reading development – in preschool, kindergarten, and first grade for typical readers" (Moats & Tolman, 2009; Sesenbaugh, 1996)

In early preschool, children's rhyming skills develop as they listen and become aware of rhymes; they respond and delight in word play and read-alouds. It is in late preschool and early elementary that children take on an even more active role, moving from listening to actively participating in rhyme. Children are not only recognizing rhyme, but are identifying them independently (i.e., "look rhymes with book") and creating their own rhymes in response (National Institute for Literacy, 2003). By identifying and making rhymes, children demonstrate phonological awareness.

Rhyming comes in full circle in a child's literacy development. First, as a reading foundational skill and an opportunity to enjoy literacy for "poetry and rhyme help young readers connect sounds to word and help them enjoy the musical, rhythmic qualities of language" (IRA & NTCE, 1996). This beginning awareness with enjoyable experiences in responding to rhyming in children's books (noticing and then doing) builds the foundation for reading, engaging with, and analyzing a wide range of literature (i.e., reading forenjoyment and for understanding) (U.S. Department of Education, 2016).

Aligning research with state and federal early learning standards suggests that children develop segmenting skills in the following progression:

- Children 2-3 years of age can demonstrate awareness and enjoyment of rhyming words through books and songs
- Children 3-4 years of age can distinguish if two words rhyme
- Children 4-5 years of age can produce rhyming words based on a given structure (I.e. "What rhymes with cat?"); can demonstrate awareness of which words rhyme given three words (I.e. Kite, bite, rug)
- Children 5-6 years of age are able to isolate the initial, medial, and final sounds in CVC words; children can recognize and produce rhyming words

Using the review of research and state and federal early learning standards, Ignite™ contains the following skill progression for the Rhyming subdomain:

Skill Level	Skill Descriptor
1	Listens to a variety of rhymes (songs, chants, etc.)
2	Determines if two words rhyme
3	Matches rhyming words
4	Determines which word does not rhyme
5	Sorts words by rhyme
6	Fills in rhyming words

Alliteration

Alliteration (similar beginning sound in words) is another skill that is acquired early on in children's phonological awareness. In early preschool, children's alliteration skills develop as they listen and become aware of and delight in word play. In late preschool and early elementary, children take on an even more active role, moving from listening to actively participating in alliteration. Children are not only recognizing alliteration but are identifying it independently (e.g., "Susie sat on the shore has lots of esses!") and creating their own alliterations in response (National Institute for Literacy, 2003). By making and identifying alliterations, and noting their common beginning sound, children demonstrate phonological awareness.

Children's phonological awareness begins with noticing and identifying alliteration. Then children, "move on to blending spoken sounds into words and dividing words into their individual sounds. The last step is learning to add, subtract, and substitute sounds to make new words" (phoneme manipulation) (Johnson, 2020).

Aligning research with state and federal early learning standards suggests that children develop alliteration skills in the following progression:

- Children 2-3 years of age can demonstrate awareness and enjoyment of alliteration through books and songs.
- Children 3-4 years of age can distinguish which spoken words have the same initial sound
- Children 4-5 years of age can produce words with the same initial sound given a prompt (I.e. "What words start with the same sound as m-m-mat?"); can begin demonstrating the isolation of initial sounds in words
- Children 5-6 years of age are able to isolate the initial, medial, and final sounds in CVC words; children can recognize and produce alliteration words

Using the review of research and state and federal early learning standards, Ignite™ contains the following skill progression for the Alliteration subdomain:

Skill Level	Skill Descriptor
1	Listens to songs and chants that have repeating initial sounds
2	Recognize when groups of words begin with the same onset
3	Distinguishes if two words start with the same onset
4	Isolates the onset in words
5	Sorts words by onset
6	Sorts words with initial diagraphs by onset

Phonics

Phonics instruction builds children's "understanding that there is a predictable relationship between phonemes (the sounds of spoken language) and graphemes (the letters and spellings that represent those sounds in written language)" (National Institute for Literacy, 2003).

The National Institute for Literacy notes that "systematic and explicit phonics instruction is most effective when introduced early…detailing that:

> *To be effective with young learners … it should include teaching letter shapes and names, phonemic awareness, and all major letter-sound relationships. … as instruction proceeds,*

> *children should be taught to use this knowledge to read and write" (2006).*

Recommended phonics instruction includes explicitly teaching of letter-sound correspondences and ensuring children have daily and numerous opportunities to practice, refine, and build upon their growing knowledge and understandings (Texas Education Agency, 2002a).

This approach to early elementary children's literacy learning and growing literacy understanding (and comprehension) is affirmed in the introduction to the Common Core State Standards for English Language Arts & Literacy, Reading Foundational Skills:

> *These standards (reading foundational standards K–5) are directed toward fostering students' understanding and working knowledge of concepts of print, the alphabetic principle, and other basic conventions of the English writing system. (NGSS, 2010)*

Given the review of relevant research related to young children's development of phonics skills, Ignite™ includes two subdomains within Phonics: Alphabet Knowledge and Letter-Sound Correspondence. These represent that most foundational phonics skills.

Alphabet Knowledge

Early childhood is a foundational period of time where all emergent reading skills are developed. For children's literacy and language development, learning, and understanding, these categories and concepts are intertwined and interdependent. They build off each other, reinforce each other, and often develop in tandem.

For example, letter-name understanding (recognizing, identifying, and knowing the letters of the alphabet) is critical for children's overall literacy learning and development. Children's understanding of letter names correlates with their knowledge of letter sounds, their identification of letter names with their production of letter sounds. It also leads to children's "alphabetic awareness (knowledge of the alphabet plus the understanding that the alphabet represents the sounds of spoken language and the correspondence of spoken sounds to written language" (Center on Teaching and Learning, n.d.). This awareness in turn informs children's understanding of print concepts, of letter–sound correspondence (phonics and word recognition), and phonemic awareness (phonological awareness).

Letter knowledge is also a strong predictor of children's success in learning to read and is "strongly related to children's ability to remember the forms of written words and their ability to treat words as sequences of letters" (Moats &

Tolman, 2009; National Early Literacy Panel, 2008; Sesenbaugh, 1996; U.S. Department of Education, 2016). And without this letter-name knowledge, children "cannot understand and apply the alphabetic principle, the idea that letters represent the sounds of spoken language" (Moats & Tolman, 2009; Sesenbaugh, 1996).

In the U.S. Department of Education report *Foundation Skills to Support Reading for Understanding in Kindergarten Through 3rd Grade*, the researchers note that because children entering kindergarten "know the names of a few letters they have learned at home or at preschool, such as the letters in their name" part of the explicit instruction around letter names should "build upon this foundation by reinforcing familiar letters and introducing new ones." (U.S. Department of Education, 2016).

Aligning research with state and federal early learning standards suggests that children develop alphabet knowledge in the following progression:

- Children 2-3 years of age are able to recognize that letters are graphemes that can be individually named; may begin to recognize some letters in their names; recognize letters in environmental print
- Children 3-4 years of age are able to recognize letters in their own names as well as some frequently encountered letters in the environment
- Children 4-5 years of age are able to recognize at least half of the alphabet
- Children 5-6 years of age are able to recognize all letters in the alphabet, working on both upper and lowercase letters

Using the review of research and state and federal early learning standards, Ignite™ contains the following skill progression for the Alphabet Knowledge subdomain:

Skill Level	Skill Descriptor
2	Listens to alphabet chants and songs
3	Recognizes 10 lower case letters
4	Recognizes 18 uppercase and 15 lowercase letters
5	Recognizes 26 uppercase and 20 lowercase letters
6	Identifies all 26 upper case letters

Letter-Sound Correspondence

Letter–sound correspondence is understanding and knowing the sound associations for individual and groups of letters (i.e., linking sounds to letters) and is part of phonics instruction (National Institute for Literacy, 2003; NELP, 2008; Strickland, 2013)

Letter–sound correspondence is also referred to as: letter–sound associations; sound–symbol correspondences; spelling–sound correspondences; sound–spellings; graphophonemic relationships; and sound–letter knowledge (National Institute for Literacy, 2003). By learning letter–sound correspondences, children develop a key foundational reading skill for "learning that there are predictable relationships between sounds and letters allows children to apply these relationships to both familiar and unfamiliar words and to begin to read with fluency" (National Institute for Literacy, 2003).

This understanding of letter–sound correspondences can be described as an "emergent literacy" skill as children's knowledge of letter names and individual letter sounds, and letter sounds for sequences of letters inform children's skills and abilities in decoding (reading) and recoding (spelling) words (phonics) (NELP, 2008; Strickland, 2013).

Letter–sound correspondence knowledge also informs children's learning and understanding of various literacy concepts and development of their literacy skills:

> *Children's reading development is dependent on their understanding of the alphabetic principle – the idea that letters and letter patterns represent the sounds of spoken language. Learning that there are predictable relationships between sounds and letters allows children to apply these relationships to both familiar and unfamiliar words, and to begin to read with fluency. (Alphabetic Principle, ReadingRockets.org).*

Children's understanding of the alphabetic principle ("the knowledge that letters in written words represent the sounds in spoken words") involves letter-name knowledge (i.e., print concepts) and understanding of letter–sound correspondence (phonics). And the "foundational ability underlying the learning of spelling-sound correspondences" is phonological awareness (Stanovich, 1993, quoted in Sesenbaugh, 1996).

Aligning research with state and federal early learning standards suggests that children develop letter-sound correspondence in the following progression:

- Children 2-4 years of age are not expected to know graphophonemic relationships at this stage of development
- Children 4-5 years of age are able to recognize at least half of letter sounds associated with their letter names (more uppercase than lowercase letters)
- Children 5-6 years of age are able to recognize the majority, if not all of the letter sounds and their associated letter names (more uppercase than lowercase letters)

Using the review of research and state and federal early learning standards, Ignite™ contains the following skill progression for the Letter-Sound Correspondence subdomain:

Skill Level	Skill Descriptor
4	Identifies 10 letters based on their sounds
5	Identifies 15 uppercase letters and 10 lowercase letters based on their sounds
6	Identifies all 26 uppercase letters and 20 lowercase letters based on their sounds

Reading

With the Common Core State Standards for English Language Arts & Literacy and with state standards on children's learning and development, there is a growing drive to ensure children become critical thinkers and do-ers in a 21st century world, that they are college and career ready. When we consider children's literacy development in this context, children not only are learning to read but are learning to exist, engage, and thrive in a global and digital world that demands the ability to read, critically analyze, and understand an almost an overwhelming amount of information and text:

Literacy skills are essential for students to fully participate in and expand their understanding of today's global society. Whether they are reading functional texts (voting ballots, a map, a train schedule, a driver's test, a job application, a text message, product labels); reference materials (textbooks, technical manuals, electronic media); or print and non-print literary texts, students need reading skills to fully manage, evaluate, and use the myriad information available in their day-to-day lives. (Colorado Department of Education, 2020a)

The focus of children's literacy (and language) learning and development now is moving beyond the idea of "reading to comprehend" (i.e., be able to read a variety of text) to "reading with purpose/reading to learn/reading to understand" (i.e., being an active thinker and reader who intentionally reads and seeks out a variety of text to learn more in a variety of disciplines/subject matter and to refine understanding). Reading to understand is a high-level analytical skill and approach to learning – as students analyze and seek out more information to build out their own individua understanding and knowledge (U.S. Department of Education, 2010, 2014, 2016).

Ignite™ by Hatch® aims to support the foundational skills of reading development expected through middle of kindergarten. Given this goal and the research, Ignite™ contains one subdomain within Reading: Concepts of Print. Additional subdomains related to reading development will be included as Ignite™ expands through kindergarten and into early first grade.

Concepts of Print

In children's literacy development, "print concepts" involves children's awareness of print, understanding of its conventions (i.e., print is organized and "read" a certain way); knowing that print carries a message; and associating the spoken or read word with print.

Print concepts include:

- Awareness of print and its connection to oral language (children's letter-name knowledge and letter-sound correspondence understanding also ensures children's understanding that letters represent words and the words on the page represent/ are connected to the spoken/read word)
- Understanding of the differences between letters, words, and sentences
- Books are handled a certain way (i.e., "how to turn pages, how to find the top and bottom of a page, and how to identify the title and the front and back covers")
- Features of books (title, author name, illustrator name, table of contents, page numbers, headings, glossaries)
- Print has meaning (i.e., "meaning is conveyed through words; that printed words are separated by spaces; and that some words in print look longer (because they have more letters) than other words") and different purposes.

According to the National Early Literacy Panel's seminal 2004 and 2008 reports on children's literacy, children's understanding of print concepts strongly predicts children's later reading, writing, and spelling abilities and understandings. Children's understanding of print concepts is also essential for their later reading proficiency: to read to understand, children need to first read and comprehend. Children's understanding of print concepts begins with kindergarten and first-grade students' awareness of print, their understanding that print carries meaning, and that the "printed language carries messages and is a source of both enjoyment and information" (U.S. Department of Education, 2010, 2014, 2016).

Children develop and refine their knowledge and understanding of print concepts by their exposure to print, i.e., a print-rich environment with adult scaffolding. Children learn by being explicitly taught print concepts, by having their awareness drawn to different concepts of print (during read-alouds and throughout the classroom day). Children need opportunities to explore and engage with a wide variety of text and books, independently and with teacher-support and teacher encouragement as needed, for research shows a strong

connection between children's beginning reading skills and their print exposure and engagement with print. These opportunities to joyfully engage and explore books builds children's "independent pleasure reading" which is "especially important for low-achieving readers, whose reading skills were even more strongly related to print exposure than were those of higher-achieving readers" (Spear-Swerling, 2018).

Aligning research with state and federal early learning standards suggests that children develop print concepts in the following progression:

- Children 2-3 years of age demonstrate understanding of print in books, and can distinguish between print and pictures
- Children 3-4 years of age demonstrate awareness that there are rules and conventions with print (I.e., orientation and directionality of print)
- Children 4-5 years of age are able to recognize that written words are made up of letters; can demonstrate understanding of book features (I.e., front, back, title, and author)
- Children 5-6 years of age are able to recognize and differentiate uppercase and lowercase letters in print

Using the review of research and state and federal early learning standards, Ignite™ contains the following skill progression for the Concepts of Print subdomain:

Skill Level	Skill Descriptor
1	Identifies appropriate book orientation
2	Distinguishes print from pictures
3	Demonstrates understanding of print directionality
4	Identifies book parts and features
5	Distinguishes letters from words
6	Distinguishes between uppercase and lowercase letters

Listening Comprehension

Listening comprehension (i.e., listening and understanding) refers to a "student's ability to follow, process, and understand spoken language." This listening and understanding and responding builds reading comprehension as well. In the 2009 Report of the National Early Literacy Panel, children's oral language comprehension and understanding was closely linked to their later reading comprehension. "Listening comprehension" includes children's understanding "comprehension of informational and narrative texts" read out loud (U.S. Department of Education, 2016).

Listening comprehension also includes understanding when various texts and books (fiction and nonfiction) are read aloud. And vocabulary knowledge and understandings (knowing the words to understand what we are listening to and are reading) underpins and strengthens listening comprehension (National Institute for Literacy, 2003).

Listening Comprehension contains one subdomain: Key Ideas and Details.

Key Ideas and Details

Young children's abilities to uncover the key ideas and details of a text is foundational to the development of meaning-making in future independent reading. When young children are active participants in a read-aloud, they are "freed from decoding and is (are) supported by the oral readers fluency, phrasing, and stress" (Fountas & Pinnell, p.12, 2020). Children are able to focus of the plot, characters, and overarching themes of a story.

Young students begin to engage with texts read aloud with various levels of teacher support, asking, and answering questions about the ideas and details of both fiction and nonfiction books. By late kindergarten, students are engaging with texts read out loud independently, without support and prompts from teachers.

Aligning research with state and federal early learning standards suggests that children develop print concepts in the following progression:

- Children 2-3 years of age demonstrate the ability to listen to and enjoy short stories
- Children 3-4 years of age demonstrate the ability to ask and answer questions about main characters or events in a story
- Children 4-5 years of age demonstrate the ability to ask and answer questions about the details of a story; children demonstrate the ability to make predictions about why something is happening in the moment within the story
- Children 5-6 years of age demonstrate greater ability to recall more complex and varied information in a story or text, making connections through activation of prior knowledge

Using the review of research and state and federal early learning standards, Ignite™ contains the following skill progression for the Concepts of Print subdomain:

Skill Level	Skill Descriptor
1	Listens to fictional texts with simple details and story elements
2	Listens to nonfiction texts with simple structures and elements
3	Identifies the main character(s) in a story

4	Recalls key details from a story
5	Recalls the order of events in a story
6	Recalls several facts from expository text

Writing

Writing is one of the most complex processes that young children develop. Children's engagement in pre-writing skills solidifies a foundation of writing that will serve them well as they enter elementary school and beyond. Writing involves developing the skills and the understandings around four broad concepts:

1. Basic writing skills (handwriting/typing and the conventions of standard English: spelling, capitalization, punctuation)
2. Text generation ("translating one's thoughts and ideas into language")
3. Writing processes ("planning, revising, and editing one's work")
4. Writing knowledge (understanding of the different purposes of writing and knowing differences and varieties of "discourse and genre") (Reading Rockets.org 2010a, b).

The U.S. Department of Education (2012) in Teaching Elementary School Students to Be Effective Writers stress the following in the introduction:

- Writing is a fundamental part of engaging in professional, social, community, and civic activities.
- Students should develop an early foundation in writing to communicate their ideas effectively and efficiently.
- Students who develop strong writing skills at an early age acquire a valuable tool for learning, communication, and self-expression
- Instructional practices in the early years, when students are just beginning to develop the process and meaning behind writing, can and will differ from practices in later grades. Writing, like reading, is defined from a developmental standpoint, which begins with the acquisition of foundational skills and then leads to the application of more sophisticated techniques.

Ignite™ by Hatch® contains one subdomain in Writing: Writing Development.

Writing Development

Children demonstrate skills, understandings, and writing development in several stages. According to the Head Start Early Learning Outcomes Framework, very young

preschool children begin to associate meaning with their writing by using scribble marks to represent people and/or objects (U.S. Department of Health and Human Services, 2015). While this is an important first step in developing the concept of writing for meaning, children's scribbles are often unstructured and undefined. However, as they develop along the writing progression, scribbling advances into letter-like forms or shapes. Children's writing becomes more controlled, with more purposeful variances of lines, often in a linear format (I.e. straight, curved, and zig-zag lines). These variances of lines, especially in a linear format, serve an important purpose for the next step in the writing progression, which includes the writing of letters. Children begin to write letters that are meaningful to them (I.e. Letters of their name or commonly seen letters in the environment). Children will then begin to use their knowledge of forming letters in more conventional ways, such as writing letters with spaces. As children develop a greater understanding of the relationships between letters and sounds within words, they will begin writing letters that represent a certain sound (I.e., labeling a picture of a sock with the letter "s"), and soon after using invented spelling (I.e., labeling a picture of a sock with "sok"). Finally, more conventional aspects of writing appear such as punctuation, capitalization, and the appearance of sight words and spelling patterns.

Aligning research with state and federal early learning standards suggests that young children's writing development occurs in the following progression:

- Children 2-3 years of age demonstrate the ability to make scribble marks that represent people or objects
- Children 3-4 years of age demonstrate the ability to write using varied, controlled lines in linear formats
- Children 4-5 years of age demonstrate the ability to use letter strings, and begin utilizing spaces in their writing
- Children 5-6 years of age demonstrate the ability to connect a written letter with its sound when labeling pictures

Using the review of research and state and federal early learning standards, Ignite™ contains the following skill progression for the Concepts of Print subdomain:

Skill Level	Skill Descriptor
1	Makes scribble marks
2	Draws pictures to convey meaning
3	Writes shape like symbols
4	Writes letter strings
5	Writes letter strings with spaces
6	Labels picture with at least the initial sound

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