### Grades K-8





The Number Lab Math Block reimagines math education through an ideas-focused approach so learners can build deep mathematical knowledge and reasoning skills.

# **OVERVIEW**

The Number Lab Math Block immerses learners in a knowledge-building community, freeing them to think critically, creatively, and independently, while also developing their communication and collaboration skills. Learners construct durable and deep knowledge structures by working collaboratively to reason their way to new understandings. They make conjectures, create algorithms, write proofs, and communicate their findings to the scrutiny of their peers.

The Math Block is implemented at Long-View Micro School in Austin, TX, which also operates as a lab for other schools and teachers working to implement the model. In addition to the 75 students at Long-View Micro School, the model has reached over 1,000 educators and their students across the country through myriad offerings. The Number Lab offers professional development, including Field Study Days (observation) at Long-View Micro School and on-site visits to partner schools, as well as physical and virtual resources, including a subscription-based website, to those interested in implementing the model.



►The Number Lab ►The Number Lab (Field Study) Video

Scan QR code with your phone's camera to access this content online.



### What Makes This Model Innovative?



The Number Lab's approach to mathematics leads children to discover the deep principles of math. Students make connections across concepts, engage in collaborative reasoning, and develop future-focused skills.



### High Expectations with Unlimited Opportunities

The "ceiling" is high both in regard to content and in how children engage in the process of learning. Math Block supports cognitive leaps and is designed to unleash reasoning.



Customization

The Number Lab Math Block puts children and their thinking at the center. Instruction is responsive to the needs of each learner, while recognizing that students are situated within a knowledge-building community.

# DESIGN

### Goals

The Number Lab focuses on creating durable knowledge structures that support quality reasoning within the discipline. Math Block provides learning experiences designed to enhance cognitive processes, learning mindsets, and pro-social behaviors that support learning in community.

Math Knowledge	Develop deep and connected knowledge structures in mathematics. View mathematics as a discipline of connected ideas and have the conceptual framework to take a generative approach to problem-solving.
Reasoning Skills	Seek out problems with a curious mindset; analyze and solve through individual and/or collaborative reasoning. Seek, analyze, and solve problems through quality reasoning and collaboration.
Agency	Develop capacity to self-organize, self-regulate, and self-reflect while proactively enriching the learning environment for oneself and others.

### Experience

The Number Lab Math Block is more of an experience than a class. Rather than just covering content in a linear trajectory like a traditional math class, the focus is the development of mathematics knowledge as multiple threads that must be braided together over time to create strong and lasting understanding. Thus, they constantly pull on threads related to multiple concepts and ways of thinking, and then bind them together for deep conceptual understanding.

At the center of The Number Lab's work is their Generative Framework for the construction of arithmetic concepts—it is applicable to all number forms and removes the need for instruction focused merely on discrete procedures. The framework allows for ways of reasoning that:

- Create connections
- Transfer across number forms to algebraic reasoning, and
- Establish a foundation for engaging in the discipline of mathematics.

In The Math Block, learners engage in authentic mathematical practices through several distinct elements: **Thought Exercises, Concept Studies, and Studio**. Usually, The Math Block consists of two different Thought Exercises, a Concept Study, and Studio. There's also always a series of brief "brain breaks," where kids go outside for fresh air, eat a snack, and just generally prepare themselves to re-engage in academic study. <u>Brain Breaks</u>

Even though The Math Block typically contains these distinct modes of engagement, the focus is on *learning* and thus the *learners* are at the center. For this reason, it will not always follow the same format but may vary based on the teacher's observations or assessments of student learning.

### **Thought Exercises**

Thought Exercises are multi-concept challenges designed to provoke thought and discussion and to expand and deepen understanding. Each component is multi-dimensional, not simply covering a singular goal, objective, or standard. Thought Exercises are routine in structure, but not routine in content. Because a Thought Exercise is delivered in the same way every time, learners know just what to expect and how to interact with the Thought Exercise. This predictability supports learners in focusing on the mathematics content and their thinking.

The six Thought Exercises that cycle across the year enhance learners' abilities to think critically; communicate this thinking clearly; challenge and/or build on the thinking of others; and recognize, refine, and/or devise novel, mathematically sound approaches to problems. The six



Thought Exercises are:

- 100 Chart <u>100 Chart</u>
- Number Line <u>Number Line</u>
- Analyzing Algorithm <u>Analyzing Algorithm</u>
- Number Study <u>Number Study</u>
- Quantitative Comparisons <u>Quantitative Comparisons</u>
- Translating Expressions & Equations **<u>Translating Expressions & Equations</u>**
- The Number Lab Products

Thought Exercises, as the name implies, are meant to develop the thinking that is crucial to the full development of mathematicians. To truly access the conceptual terrain, teachers need to work to develop the thinking skills of their learners—both generally and with specific regard to mathematics. Thus, these are exercises in *thought* and require the teacher to deliver them in ways that prompt learners to grow more sophisticated ways of thinking.



During Thought Exercises, the teacher's role is to

mediate discussions. The teacher provides prompts that are substantial enough in content to elicit robust conversation, asks the questions necessary to help learners when they appear stuck, and encourages learners to problem-solve through a more thorough search of their knowledge or deeper critical analysis of the information that is under investigation. Frompts That Invite Discourse The teacher must also remain cognizant of the models learners use to help illustrate their thinking, the precision of the language they use to explain their thinking to others, the way in which they challenge and/or offer support for their ideas, and the mathematical justification of the ideas presented.

### **Concept Study**



The Concept Study is the "lesson" segment of The Math Block. It is devoted to constructing or deepening understanding of a mathematical concept. Concept Studies are thoughtfully prepared, focused community discussions. A Concept Study is typically composed of a series of expressions combined with very intentional questions to lead learners from their prior knowledge to new mathematical terrain. Through this purposefully formulated series of prompts, learners make cognitive leaps that build on or

extend their math knowledge. This is The Number Lab's way of pulling on the various threads of

mathematical ideas and knowledge that learners have attained and binding them together for learners to move to a robust understanding of concepts.

During Concept Studies, as in every aspect of The Math Block, questions provide the support and scaffolding needed for learning instead of the teacher "showing" or "telling" learners what they must do. And not unlike Thought Exercises, Concept Studies facilitate discourse. When learners are engaged in discourse, they formulate, communicate, and critically assess arguments. Teachers invite, encourage, and coach learners to communicate and grapple with conflicting claims and counterarguments. In this way, they normalize the messiness of learning and recognize that struggle is intrinsic to learning. <u>Concept Study</u>

### Studio

Studio typically follows Concept Study and allows learners to immerse themselves in working as mathematicians. This happens at whiteboards where partners collaborate and present their work to their peers for inspection and discussion. Partners explore problem sets that require a variety of mathematical understandings, which supports differentiation. Through these problem sets, learners practice the new ideas discussed during a Concept Study and begin encoding these ideas into their stock of knowledge. This is not "worksheet mastery practice" but rather an opportunity to try out new ideas and rehearse thinking aloud with support from a partner.

During Studio, a learner's ability to collaborate is perhaps more evident than in any other element of The Number Lab Math Block. As partners work through a problem set, one partner is the designated scribe, yet both partners must reach consensus on the approach to a particular problem as well as the way their thinking is illustrated. The norm for collaboration during Studio is captured by a common refrain: "One Marker, Two Minds," and to further support this refrain, creating together is constantly modeled, coached, and commended. Learners are encouraged to listen critically to one another so that they recognize that learning comes from many sources, especially their peers.



Additionally, learners are supported as they attempt to use strategic questioning to scaffold for their partners. All of the coaching that learners receive is lean—teachers drop in and listen to the exchange between partners and give minimal feedback, being careful not to take away the learning opportunity and to provide just enough feedback so that the learners can incorporate it into their practice. Lastly, learners work with their partners for several weeks so they have ample time to develop productive partnerships. Estudio Sampler

### **Supporting Structures**

The Number Lab reimagines traditional, industrial-era math instruction. Though the model can be implemented across various learning environments, it requires significant shifts to the way most schools approach instruction, culture, adult roles, schedules, and space as described below.

# The Number Lab Math Block reimagines math instruction to be a collaborative and student-centered learning experience.

A Math Block classroom looks and sounds very different from a traditional classroom. Decades of math pedagogy focused on teacher-driven instruction, followed by independent practice to cement a particular skill. The Number Lab rejects most elements of this paradigm, including the antiquated belief that learning math needs to be a solitary activity and that kids should move from a teacher-constructed activity to a worksheet, ticking off the tasks as they complete them. Rather, The Math Block is focused on immersing learners in a *mathematics experience*.



CURRICULUM, Instruction, & Assessment Much of the learning is driven by discussion. Recognizing the power of language to empower (or disempower), they consider the use of language carefully during The Math Block. Learners frequently use the phrase "I agree" or "I disagree" when discussing mathematics because it does not assume rightness or wrongness; it allows a learner to respond with their own rationale and share their thinking with others, ultimately moving toward justification that is accepted by the whole community, inclusive of the teacher. In addition, from the earliest ages, learners speak in terms of properties, concepts, and ideas. They use appropriate mathematics terminology because they believe that learners and educators are mathematicians and should demand the tools of the discipline.

Assessment is a crucial and ongoing component of The Number Lab Math Block. Data is collected in the form of photos, videos, scripts, and anecdotal notes to provide insight on learning beyond content knowledge. This requires both constant effort to ensure the thinking of learners is always visible, as well as teachers consistently and collectively analyzing artifacts of students' work. In addition, teachers are always assessing the ideas shared during discussions to determine learners' depth of understanding as well as their ability to convey their thinking. Teachers also move about the classroom while learners work in pairs, listening to and analyzing the thinking that learners record on whiteboards and providing immediate feedback specific to the learner.

### Fostering community and a strong culture are critical to enabling learners to engage in and collaborate on complex tasks with a growth mindset.

Helping learners to operate as a community is crucial. The tasks or

problems they contend with are very complex and require a range of skills, insights, and experiences to be solved. A classroom that operates as a learning community is founded on the understanding that the growth of knowledge involves both individual and social processes and aims to enhance both individual and group learning. This occurs through supporting individual contributions to a communal effort. Disciplined discourse is key; the point of learning is to share it with others. The main agent of inquiry is a knowledge-building community, and conceptions of learning are rich and co-constructive. **Learning Happens When** 

> In The Math Block, the cultural emphasis is on learning; anything that distracts from learning is called out or becomes a point of important discussion. The community holds every member accountable for her/his individual choices. "Classroom management" by a teacher is virtually non-existent as learners are expected to set boundaries, provide feedback, and make choices that prioritize learning. This kind of constant, honest feedback is also employed during math discussions.

# Teachers don't follow prescriptive lesson plans; they strategically and responsively facilitate student discourse to curate a learning experience.



The teacher is, of course, the curator of the student experience. However, in The Math Block, the teacher moves away from being the center of power and becomes more responsive, reflexive, and respectful. In addition, every community member (adult and child) is a learner and thus teachers recognize that they are ultimately on a journey as a learner too. Teachers constantly evaluate learner questions and ask their own questions. They take risks in their practice, giving themselves the same space and grace that they seek to encourage in learners. In addition, they give each other the kind of honest feedback that they encourage learners to give one another.

Educators who have studied with The Number Lab commit to critical planning and avoid prescriptive lesson plans that often promote teacher-centeredness. Teachers begin planning by thinking first and foremost about creating an experience that will immerse learners in mathematics. In addition, they spend time thinking about how to create connections across content. Esson Plan"\*

*\*While The Number Lab educators don't think about "lesson plans" in the* 



traditional way, the sample "lesson plan" is an example of how a 2nd/3rd-grade band might experience a study on unitization. The sample is not meant to serve as a script but to support you in creating and designing a Math Block experience for your unique learners.

# The Math Block requires extended time that allows for deeper understanding.



Time is a crucial element in the design of The Number Lab Math Block. In order for learners to dive deep into a concept and grapple with it—formulating and iterating conjectures—they need ample time. Thus, The Math Block is typically two hours. The two hours are broken into several distinct modes of engagement: Thought Exercises, Concept Studies, and Studio. There's also always a series of brief "brain breaks," where kids go outside for fresh air, eat a snack, and just generally prepare themselves to re-engage in academic study. Sample Schedule

# The physical space should encourage collaboration, agency, and flexibility.

All aspects of the physical layout of the classroom are designed with intention so that learners recognize that the space they inhabit is theirs, not that of the teacher, the institution, or another external authority.

Classrooms are covered with writing surfaces for students versus bulletin boards and prepackaged posters. These may be on walls, rolling whiteboards, and even windows. This maximizes space for learners to collaborate freely and flexibly and focuses student attention on learning. Long-View builds its own rolling whiteboards, called "Z Racks," which are critical for facilitating and assessing learning. ► How To Build Your Own Rolling Whiteboard 📑 How To Build Your Own Rolling Whiteboard



To encourage movement rather than trying to inhibit it, Long-View Micro School—The Number Lab's lab school—designs ways to keep bodies moving and changing positions. They use gray foam cubes inspired by the d.school, which are comfortable, easily moved, and accommodate kids who need to wiggle, rock, lay on their



stomachs, etc. They typically arrange the cubes in a half-circle configuration or full-circle configuration, but the cubes also get used as chairs at adjustable tables or even as "desks" themselves. In addition, learning spaces are shared, supplies are open and visible, and materials are hardy and simple. Learning spaces are largely built by teachers with an occasional hack created by a student to solve a community need.

# **IMPLEMENTATION**

### **Supports Offered**

<u>The Number Lab</u> offers the following supports to help you implement their model. <u>Menu of</u> <u>Offerings</u>

Learning For The Long-View Cost Associated



[**Co]lab** Cost Associated





Professional Development Cost Associated



The Number Lab offers a subscription-based website for educators to support the implementation of their model. The goal is to give teachers sustained support in developing content knowledge and shifting to a more complex pedagogy in a more personal, just-in-time format.

### Learn More

The [Co]lab is a 3-day summer workshop for educators to conceive of and catalyze change in their classrooms. The workshop supports participants in shifting to a philosophical understanding and pedagogy that is learner-centered and supports deep understanding of a discipline. ►[Co]lab video

### Learn More

Attend a Field Study Day for an immersive experience at <u>Long-View</u> <u>Micro School</u>, which serves as a lab for the continued evolution of The Number Lab. Participants are embedded in a classroom (half-day) or immersed in all aspects of the school (full-day) to conceive of change and to re-think culture and assumptions.

### Learn More

All PD is centered on children—workshops are very active and include learning through photos and videos of students as they are working on their own mathematics or are situated directly within the classroom environment.

### <u>Learn More</u>

### Reach

# 1,000415650EducatorsSchool VisitsResource<br/>Downloads

### Impact

The Number Lab has worked with hundreds of educators across the nation and the world to reconsider the thinking and practices associated with traditional mathematics teaching. As a result, the schools and school districts that have adopted The Number Lab's approach to teaching and learning mathematics are seeing the growth of their own students.

- Over 92% of participants at the [Co]lab rated their overall experience highly and said they would recommend it to colleagues.
- "We are seeing growth in our classrooms that we believe can be attributed to the shifts those teachers have made as a result of their work with [The Number Lab]."
- "Having taught many different curriculums, I feel that [The Number Lab] hits the core of a student's number sense at such a young age that it makes the language and concepts of math seamless through the grades."

In addition, at Long-View Micro School, the flagship and learning site, students show promising results. In 2021, incoming 2nd graders who scored below the national benchmark on the Test for Early Mathematical Ability (TEMA) grew an average of 164% from the beginning of the year (BOY) to the middle of the year (MOY).

### Contact

**Cathy Lewis** Co-Founder / Director of Programs <u>clewis@thenumberlab.com</u>

# RESOURCES

# the**number**lab

The Number Lab Video

An overview of The Number Lab's approach to mathematics and The Math Block model.



<u>The Number Lab (Field Study)</u> <u>Video</u>

A video of Field Study, a professional learning experience in which The Number Lab hosts educators to experience their approach to mathematics education.

## thought exercise thou

100 CHART

Our 100 Chart Thought Exercise supports learners in developing efficient ways to think about number in reference to 10. Long Ylew's 400 Carot is unique in that in ing "your the chart reflects on increase traffer than the form "up" the chart reflects on increase traffer than the traditional chart where increasing is achieved by going 'down' the chart. Long View's 100 Chart can be downloaded from our website and a Field Guide for the 100 Chart, with numerous examples and meet support on implementation, can be purchased from our Products page. During this Thought Exercise, the prompts, like the ones shown below, are each read

During this Thought Exercise, the prompts, like the ones shown below, are each read oloud three times. Learners work with partners to consider the prompts, using the 100 Chart to track thinking. It is important to read through all of the prompts, rother than stopping the class to ensure each partnership has "arrived correctly" of each value in the provide the provided of the provided the provided of the pro

### <u>100 Chart</u>

This Thought Exercise supports learners in developing efficient ways to think about numbers in reference to 10. You can download the accompanying 100 Chart from their <u>website</u> for free.

#### thought exercise

#### NUMBER STUDY

In our Knuber Study Thought Exercise, learners analyze elements within a given ear or sets in order to find connections, articulate properties or drow conclusions about hose elements. This Thought Exercise occurs in a whole group format, with the community of mathematicians expansion of the state of

ふをしゅうえいき ろ

### Number Study

In this Thought Exercise, learners analyze elements within a given set(s) to find

#### thought exercise NUMBER LINE

Through critical analysis of number positioning on a number line, the Number Line Through Cercise is an important experience in order to help learners build understanding of, among many things, number relationships - magnitude, difference/range, median, etc.; ordinality; substitution principle; and proportionality. Begin the services by having learners consider that which would make plotting the numbers an easier task. Ask: "What position on the number line or number that is number due to selve task. Ask: "The position on the number line or number that is number that is the nickbart of the two extremes. To determine the median, lead learners in a discussion than includes understanding and use of the range; distance, in whole units, from the lower actemes to the middle extreme or vice versa. In this case, the range is 3.75.

### Number Line

This Thought Exercise supports learners to build an understanding of number relationships.

### thought exercise

#### QUANTITATIVE COMPARISONS

In our Quantitative Comparison Thought Exercise, learners evaluate the expression on the left in comparison to the expression on the right, ultimately deciding whether the expressions are equivalent or less than/greater than. This Thought Exercise and a strain of the group format, with the community of mathematicions engaging in discourse together, discussing and justifying ideas. Singlocity we have one learner evaluate a particular expression and then explain/justify how it compares to the other; the learner does this while standing in front of the mathematics community. Debate often ensues as the community evaluates the quality of the thinking and wrestles with whether the garger or disagree with the justification.

### Quantitative Comparisons

In this Thought Exercise, learners evaluate and compare expressions and

# **Brain Breaks**

Brain breaks bring attention to the physical, mental, and social needs of learners that results in an impact of learning and community flourishment.

### Brain Breaks Infographic

An infographic that explains the rationale behind "brain breaks," which brings attention to the physical, mental, and social needs of learners.

### thought exercise ANALYZING ALGORITHM

### Analyzing Algorithm

In this Thought Exercise, learners analyze algorithms and determine if there is sound reasoning, referencing properties, postulates, and/or theorems.

#### thought exercise TRANSLATING EXPRESSIONS & EQUATIONS

The Translating Expressions + Equations Thought Exercise, allows learners practice with mathematizing practical scannich, Each partnership of how to three learning space that whiteboard and a single marker, and partners should occupy on area of the learning space that partnerships. Once the partners are settled in their spaces, they must decide which of them will set the. When setting a security to tread doub, decimes has that determine whether the base that the source of the setting security of the setting security and sections. When the constitution of mathematical security and setting the security of a security of ways, encouraging definess of thought a learners are compiled to consider and make connections between understandings that they have

Translating Expressions & Equations In this Thought Exercise, learners mathematize





### <u>Sample "Lesson Plan"</u>

A sample "lesson plan" for how a 2nd/3rd grade band might experience a study focused on unitization. The sample is not meant to serve as a script but to support you in creating and designing a Number Lab experience for your unique learners.



### Sample Schedule

A sample schedule from Long-View Micro School, with long blocks of time for each subject area, which allows learners to dive deep into and grapple with a concept.



### How To Build Your Own Rolling Whiteboard Video

A video that walks you through how to build your own rolling whiteboard, which is critical for facilitating and assessing learning.

#### Building Your Own Rolling Whiteboard

The way we think about our classroom space was very much impacted by Stantord's dischool, IDEO, and trog design Space is the Kuwdatian for the expression of our cultural values. David Kelley



Let now We like them, but Anno New, but more detailed and inder not personally than the of any bandy source and the second seco

### How To Build Your Own Rolling Whiteboard Guide

An overview of how to build your own rolling whiteboard, which is critical for making thinking visible.



<u>Menu of Offerings</u> Learn more about the myriad of services The Number Lab offers to help you implement their model.



### [Co]lab Video Hear from educators about their experience in the [Co]lab (formerly called the Collaboratory), a 3-day summer workshop for educators to learn about and experience The Number Lab's approach to mathematics.