Introduction

1. Key Components of the JUMP Math Resources

Student Workbooks Parts 1 and 2, Grades 1–8

- Solid foundation for each of the strands in the curriculum at grade level
- Extensive review going back up to two grades
- All strands complete the curriculum at grade level

Teacher's Guides, Grades 1–8

Overview of JUMP Math
Mental Math Unit
Detailed Table of Contents (Parts 1 and 2)
Lesson plans provide clear explanations and explicit guidance on how to

- Introduce one concept at a time
- Explore concepts and make connections in a variety of ways
- Assess students quickly
- Extend learning with extra bonus questions and activities
- Develop problem solving skills
- Support material for each strand

BLMs (extra worksheets, games, manipulatives, etc.)
Answer Keys (for Workbooks and Unit Tests), Grades 3–8
Unit Tests, Grades 3–8
Curriculum Correlations (WNCP, ON)

2. The Myth of Ability

There is a prevalent myth in our society that some people are born with mathematical talent—and others simply do not have the ability to succeed.

Recent discoveries in cognitive science are challenging this myth of ability. The brain is not hard-wired; it continues to change and develop throughout life. Steady, incremental learning can result in the emergence of new abilities. The brain, even when damaged, is able to rewire itself and learn new functions through rigorous instruction. As Philip E. Ross points out in his 2006 *Scientific American* article "The Expert Mind," this fact has profound implications for education:

> The preponderance of psychological evidence indicates that experts are made not born. What is more, the demonstrated ability to turn a child quickly into an expert—in chess, music, and a host of other subjects—sets a clear challenge before the schools. Can educators find ways to encourage the kind of effortful study that will improve their reading and math skills? Instead of perpetually pondering the question, "Why can't Johnny read?" perhaps educators should ask, "Why should there be anything in the world that he can't learn to do?"[1]

JUMP Math builds on the belief that every child can be successful at mathematics by

- promoting positive learning environments and building confidence through praise and encouragement;
- maintaining a balanced approach to mathematics by concurrently addressing conceptual and procedural learning, explicit and inquiry-based learning;

- achieving understanding and mastery by breaking mathematics down into sequential, scaffolded steps, while still allowing students to make discoveries;
- keeping all students engaged and attentive by "raising the bar" incrementally;
- guiding students strategically to explore and discover the beauty of mathematics as a symbolic language connected to the real world; and,
- using continuous assessment to ensure all students are engaged and none are left behind.

JUMP Math is an approach to teaching mathematics that has been developed by John Mighton and a team of mathematicians and educators who are dedicated to excellence in mathematics teaching and learning.

3. About JUMP Math

> Nine years ago I was looking for a way to give something back to my local community. It occurred to me that I should try to help kids who needed help with math. Mathematicians don't always make the best teachers because mathematics has become obvious to them; they can have trouble seeing why their students are having trouble. But because I had struggled with math myself, I wasn't inclined to blame my students if they couldn't move forward.
> — John Mighton[2]

John Mighton is a mathematician, bestselling author, award-winning playwright, and the founder of JUMP Math, a national charity dedicated to improving mathematical literacy.

JUMP Math grew out of John's work with a core group of volunteers in a "tutoring club" held in his apartment to meet the needs of the most challenged students from local schools. Over three years, John developed the early material—simple handouts for the tutors to use. This period was one of experimentation in developing the JUMP Math method through countless hours of one-on-one tutoring. Eventually, John began to work in local inner-city schools, placing tutors in classrooms. This led to the next period of innovation—working through the JUMP Math method in classrooms.

Teachers responded enthusiastically to their students' success and wanted to adapt the method for classroom use. John and a group of volunteers and teachers developed workbooks to meet teachers' needs for curriculum-based resources. These started out as a series of three remedial books with limited accompanying teacher materials, released in fall of 2003. The effectiveness of these workbooks led quickly to the development of grade-specific, curriculum-based workbooks and teacher's guides, first released in 2004.

John documented his experience in two national bestselling books, *The Myth of Ability* (2003) and *The End of Ignorance* (2007). As a playwright, he has won several national awards, including the Governor General's Literary Award for Drama, the Dora Award, the Chalmers Award, and the Siminovitch Prize. John was granted a prestigious Ashoka Fellowship as a social entrepreneur for his work in fostering mathematical literacy by building students' self-confidence and competence through JUMP Math. In 2010 John was appointed an Officer of the Order of Canada.

In only ten years, JUMP Math has grown from a gathering around John's kitchen table to a thriving organization reaching more than 50,000 students with high-quality learning resources and training for 3,000 teachers. JUMP Math is working in hundreds of schools across Canada and internationally, and has established a network of dedicated teachers who are mentoring and training teachers new to the program. As well, JUMP Math supports community organizations in reaching struggling students through homework clubs and after-school programs. Through the generous support of our sponsors, JUMP Math donates learning resources to classrooms and homework clubs across

Canada. JUMP Math has inspired thousands of community volunteers and teachers to reach out to struggling students by donating their time as tutors, mentors, and trainers.

4. JUMP Math Works

JUMP Math is a learning organization committed to evaluation and evidence-based practice. JUMP Math is a leader in encouraging and supporting third-party research to study the efficacy of the JUMP Math approach to mathematics teaching and learning.

Hospital for Sick Children 2008–2010

Cognitive scientists from The Hospital for Sick Children in Toronto conducted a randomized-controlled study of the effectiveness of the JUMP Math program. Studies of such scientific rigour remain relatively rare in mathematics education research in North America. The results showed that, on well-established measures of math achievement, students who received JUMP instruction outperformed students who received the methods of instruction their teachers would normally use.

Ontario Institute for Studies in Education (OISE) 2007–2008

Researchers from OISE at the University of Toronto, led by Dr. Joan Moss, completed a one-year study on the efficacy of JUMP Math. Preliminary data indicate that

- JUMP Math's Grade 5 resources for the curriculum in multiplication provide a greater variety of representations of concepts and more practice than provincially recommended programs; and
- JUMP Math significantly improves the conceptual understanding of math for struggling students.

Vancouver School Board 2006–2007

Over the school year, 68 JUMP Math teachers were surveyed. The teachers indicated that

- the JUMP Math methodology enhances student retention and transfer, promotes independent thinking, and creates excitement and curiosity; and
- JUMP Math develops teacher confidence and self-efficacy.

Borough of Lambeth (London, UK) 2006–2009

During the summer of 2006, 24 public schools in Lambeth participated in a pilot study on JUMP Math. As a result of the pilot's impact on student behaviour, confidence, and achievement—as well as teachers' strong reaction to JUMP Math as an effective teaching tool—a total of 35 local schools adopted the program for the 2006–2007 school year. In this second implementation, 69% of the students who initially performed two years below age-related expectations moved up multiple levels after using JUMP Math, and either reached or surpassed their desired level by the end of the school year. In 2008–2009, it was shown that 57% of students who were initially at grade level progressed three years ahead of national expectations for their age.

JUMP Math Evaluation Pilot 2007–2008

After using JUMP Math as their exclusive math program during a 5-month pilot study, a class of Grade 3 students in British Columbia showed

- an increase in math achievement equivalent to 9 months of instruction (80% more than the expected achievement in 5 months); and
- a statistically significant decrease in math anxiety and a statistically significant increase in positive attitude toward math.

In 2010, JUMP Math was recommended by the Canadian Language and Literacy Research Network and the Canadian Child Care Federation in a report entitled "Foundations for Numeracy: An Evidence-Based Toolkit for the Effective Mathematics Teacher."[3]

In 2009, JUMP Math was recognized by the UK Government in the document "What Works for Children with Mathematical Difficulties?"[4]

See the JUMP Math website, www.jumpmath.org, for more details and updates on research.

5. What Is the JUMP Math Approach?

JUMP Math is a balanced approach to teaching mathematics that supports differentiated instruction. JUMP Math covers the full curriculum for both Ontario and Western Canada through student workbooks, teacher's guides, and a range of support materials.

The JUMP Math student workbooks are not intended to be used without instruction. Teachers should use the workbooks and accompanying lesson plans in the teacher's guides for dynamic lessons in which students are allowed to discover and explore ideas on their own. The careful scaffolding of the mathematics in the student workbooks make them an excellent tool for teachers to use for guided practice and continuous assessment.

The JUMP Math approach to teaching mathematics emphasizes:

- Confidence-building
- Guided practice
- Guided discovery
- Continuous assessment
- Rigorously scaffolded instruction
- Mental math
- Deep conceptual understanding

Confidence-building

JUMP Math recognizes that math anxiety is a significant barrier to learning for many students. The JUMP approach has been shown to reduce math anxiety by building on success in small steps. Raising the bar incrementally—a key component of the JUMP Math materials—encourages engagement and confidence. The research in cognition that shows the brain is plastic also shows that the brain can't register the effects of training if it is not attentive. However, a child's brain can't be truly attentive unless the child is confident and excited and believes that there is a point in being engaged in the work. When students who are struggling become convinced that they cannot keep up with the rest of the class, their brains begin to work less efficiently, as they are never attentive enough to consolidate new skills or develop new neural pathways. That is why it is so important to give students the skills they need to take part in lessons and to give them opportunities to show off by answering questions in front of their classmates. To do this, try to constantly assess what struggling students know.

Guided practice

Research in psychology has shown that our brains are extremely fallible: our working memories are poor, we are easily overwhelmed by too much new information, and we require a good deal of practice to consolidate skills and concepts. Repetition and practice are essential. Even mathematicians need constant practice to consolidate and remember skills and concepts. New research in cognition shows how important it is to practise and build component skills before students can understand the big picture. The workbooks are designed to provide guided practice when used

with the lesson plans. The multiple representations of mathematics in JUMP Math combine with guided practice in small steps to promote mastery and understanding of key concepts.

Guided discovery

In "Students Need Challenge, Not Easy Success,"[5] Margaret Clifford makes the case that students benefit when they are given prompt, specific feedback on their work and when they are allowed to take "moderate risks." JUMP Math provides moderate risks by providing tasks that are within students' grasp. As students' confidence grows, their risk tolerance grows as well, and they are ready to take more and more steps by themselves.

The lesson plans in the JUMP Math teacher's guides show you how to build lessons around the material in the workbooks by creating tasks and questions similar to the ones on the worksheets. As much as possible, when students are ready, allow them to think about and work on these questions and tasks independently rather than teaching them explicitly. When you feel your students have sufficient confidence and the necessary basic skills, let them explore more challenging or open-ended questions.

Students are more likely to become flexible and independent thinkers in math if you guide discovery through well-designed lessons. Hence, in creating discovery-based lessons it is important to balance independent work with practice and explicit hints and instruction. According to Philip E. Ross,[6] research in cognition shows that to become an expert in a game like chess it is not enough to play without guidance or instruction. The kind of training in which chess experts engage, which includes playing small sets of moves over and over, memorizing positions, and studying the techniques of master players, appears to play a greater role in the development of ability than the actual playing of the game.

Continuous assessment

JUMP Math workbooks are designed to allow for continuous formative assessment—the books show teachers how to break material into steps and assess component skills and concepts in every area of the curriculum.

The point of constantly assigning tasks and quizzes is not to rank students or to encourage them to work harder by making them feel inadequate. Quizzes should instead be treated as opportunities for students to show off what they know, to become more engaged in their work by meeting incremental challenges, and to experience the collective excitement that can sweep through a class when students experience success together. Continuous assessment allows the teacher to differentiate instruction with small individual interventions.

Rigorously scaffolded instruction

Consistent with emerging brain research, JUMP Math provides materials and methods that minimize differences among students, allowing teachers to more effectively improve student performance in mathematics. In "Why Minimal Guidance During Instruction Does Not Work," Paul Kirschner, John Sweller, and Richard Clark argue that evidence from controlled studies almost uniformly supports direct, strong instructional guidance.[7] Even for students with considerable prior knowledge, strong guidance while learning helps take into account the limitations of a student's working memory: the mind can only retain so much of new information or so many component steps at one time.

Even in discovery-based lessons, in which there is little direct instruction, it is important to introduce new ideas through a series of well-designed tasks and explorations in which each new concept follows from the last; students are more likely to make discoveries if the progression of ideas makes sense to them and does not overwhelm them.

Mental math

Mental math is the foundation for all further study in mathematics. Students who cannot see number patterns often become frustrated and disillusioned with their work. Consistent practice in mental math allows students to become familiar with the way numbers interact, enabling them to make simple calculations quickly and effectively without always having to recall their number facts.

To solve problems, students must be able to see patterns in numbers and make estimates and predictions about numbers. It is a serious mistake to think that students who don't know number facts can get by in mathematics using a calculator or other aids. Students can certainly perform operations and produce numbers on a calculator, but unless they have number sense, they will not be able to tell if their answers are correct, nor be able to develop a talent for solving mathematical problems.

Deep conceptual understanding

JUMP Math scaffolds mathematical concepts rigorously and completely. JUMP Math materials were designed by a team of mathematicians and educators who have a deep understanding of, and a love for, mathematics. JUMP Math teaches symbolic and concrete understanding simultaneously, using a variety of approaches. JUMP Math materials offer multiple symbolic and concrete representations for all key mathematical concepts, and provide guided practice for mastery, allowing students to master and understand each representation completely before moving on.

JUMP Math shows teachers how to see the big ideas of mathematics in even the smallest steps, how to make sense of the individual steps in a mathematical procedure or problem, and how to relate them to the wider concept. JUMP Math teaches fundamental rules, algorithms, and procedures of mathematics for mastery, but students are enabled to discover those procedures themselves (as well as being encouraged to develop their own approaches) and are guided to understand the concepts underlying the procedures fully.

6. Building Confidence with the Introductory Unit

> In the twenty years that I have been teaching mathematics to children, I have never met an educator who would say that students who lack confidence in their intellectual or academic abilities are likely to do well in school. Our introductory unit has been carefully designed and tested with thousands of students to boost confidence. It has proven to be an extremely effective tool for convincing even the most challenged student that they can do well in mathematics.
> —John Mighton, in conversation

In recent years, research has shown that students are more likely to do well in subjects when they believe they are capable of doing well. It seems obvious, then, that any math program that aims to harness the potential of every student would start with an exercise that builds the confidence of every student. Getting Ready for JUMP Math: Introductory Unit Using Fractions, which can be downloaded from www.jumpmath.org, was designed for just this purpose. The Introductory Unit does not teach fractions in depth: you will find a more comprehensive approach to teaching fractions in the relevant JUMP Math workbooks and teacher's guides. We recommend that teachers only use the unit for several weeks, preferably at the beginning of the school year.

The individual steps that teachers will follow in teaching the unit are extremely small, so even students who struggle most needn't be left behind. Throughout the unit, students are expected to

- discover or extend patterns or rules on their own,
- see what changes and what stays the same in sequences of mathematical expressions, and
- apply what they have learned to new situations.

Students become very excited at making these discoveries and meeting these challenges as they learn the material. For many, it is the first time they have ever been motivated to pay attention to mathematical rules and patterns or to try to extend their knowledge in new cases.

The Introductory Unit Using Fractions, which consists of students worksheets and a short teacher's guide, has been specifically designed to build confidence by:

- Requiring that students possess only a few simple skills — These skills can be taught to even the most challenged students in a very short amount of time. To achieve a perfect score on the final test in the unit, students need only possess three skills: they must be able to skip count on their fingers, add one-digit numbers, and subtract one-digit numbers.
- Eliminating heavy use of language — Mathematics functions as its own symbolic language. Since the vast majority of children are able to perform the most basic operations (counting and grouping objects into sets) long before they become expert readers, mathematics is the lone subject in which the vast majority of children are naturally equipped to excel at an early age. By removing language as a barrier, students can realize their full potential in mathematics.
- Allowing you to continually provide feedback — In the Introductory Unit, the mathematics are broken down into small steps so that you can quickly identify difficulties and help as soon as they arise.
- Keeping students engaged through the excitement of small victories — Children respond more quickly to praise and success than to criticism and threats. If students are encouraged, they feel an incentive to learn. Students enjoy exercising their minds and showing off to a caring adult.

Since the Introductory Unit is about building confidence, work with your students to ensure that they are successful. Celebrate every correct answer. Take your time. Encourage your students. Point out that fractions are considered to be one of the most difficult topics in mathematics. Have fun!

7. Using JUMP Math in the Classroom

JUMP Math supports a balanced approach to teaching mathematics. In the teacher's guides you will find lesson plans which include everything from group work to explorations. Below are some recommendations for using JUMP Math.

Teach at regular intervals.

Build a lesson around the material on a particular worksheet by creating questions or exercises that are similar to the ones on the worksheet. Discuss one or two skills or concepts at a time with the whole class, allowing students to develop ideas by themselves, but giving hints and guidance where necessary. Ask questions in several different ways and allow students time to think before you solicit an answer, so that every student can put their hand up and so that students can discover the ideas for themselves. After presenting a particular concept, do not go on until all of the students are assessed and show a readiness to move ahead.

Give mini-quizzes.

Each time you cover a concept or skill, assign a mini-quiz consisting of several questions or a straightforward task to see exactly what students have understood or misunderstood. Write questions or instructions on the board and let students work independently in a separate notebook (or with concrete materials when indicated by the teacher's guide). Depending upon the topic you

are working on, assign questions from the workbooks only after going through several cycles of explanations (or explorations) followed by mini-quizzes. Check the work of students who might need extra help first, then take up the answers to the quiz at the board with the entire class. If any of your students finish a quiz early, assign extra questions.

Assess continuously.

The secret to bringing an entire class along at the same pace is to use "continuous assessment." When students are not able to keep up in a lesson it is usually because they are lacking one or two basic skills that are needed for that lesson, or because they are being held back by a simple misconception that is not difficult to correct. Make an effort to spot mistakes or misunderstandings right away. If you wait too long to correct an error, mistakes pile upon mistakes so that it becomes impossible to know exactly where a student is going wrong. To spot mistakes, it helps to break material into small steps or separate concepts, so the worksheets are an ideal tool for assessing mistakes and misunderstandings.

Prepare bonus questions.

Be ready to write bonus questions on the board from time to time during the lesson for students who finish their quizzes or tasks early. Bonus questions and extensions are included in most of the lesson plans. While students who finish quickly are occupied with these questions, circulate around the class doing spot checks on the work of students who are struggling. The bonus questions you create should generally be simple extensions of the material (see How to Create Bonus Questions below).

If a student doesn't understand your explanation, assume there is something lacking in your explanation, not in your student.

Rephrase or reword explanations if a student doesn't understand. Sometimes lessons go too fast for a student or steps are inadvertently skipped. Taking time to reflect on what worked and didn't work in a lesson can help you reach even the most challenged students. When students are struggling always ask, "How could I have improved the lesson?"

In mathematics, it is always possible to make a step easier.

The exercises in the JUMP Math workbooks break concepts and skills into small steps and in a coherent order that students will find easy to master. The lesson plans in the teacher's guides provide many examples of extra questions that can be used to fill in a missing step in the development of an idea if a problem occurs.

Introduce one piece of information at a time.

Teachers often inadvertently introduce too many new pieces of information at the same time. In trying to comprehend the final item, students can lose all memory and understanding of the material that came before, even though they may have appeared to understand this material completely as it was being explained.

According to Herb Simon, who won the Nobel Prize for his work on the brain, research in cognition shows that, "… a learner who is having difficulty with components can easily be overwhelmed by the processing demands of a complex task. Further, to the extent that many components are well mastered, the student wastes much less time repeating these mastered operations to get an opportunity to practice the few components that need additional effort."[8]

John Mighton once observed an intern from teachers' college who was trying to teach a boy in a Grade 7 remedial class how to draw mixed fractions. The boy was getting very frustrated as the

intern kept asking him to carry out several steps at the same time. Here is how John separated the steps to facilitate understanding and success:

> I asked the boy to simply draw a picture showing the number of whole pies in the fraction 2 1/2. He drew and shaded two whole pies cut into halves. I then asked him to draw the number of whole pies in 3 1/2, 4 1/2 and 5 1/2 pies. He was very excited when he completed the work I had assigned him, and I could see that he was making more of an effort to concentrate. I asked him to draw the whole number of pies in 2 1/4, 2 3/4, 3 1/4, 4 1/4 pies, then in 2 1/3, 2 2/3, 3 1/3 pies, and so on. (I started with quarters rather than thirds because they are easier to draw.) When the boy could draw the whole number of pies in any mixed fraction, I showed him how to draw the fractional part. Within a few minutes he was able to draw any mixed fraction. If I hadn't broken the skill into two steps (i.e., drawing the number of whole pies then drawing the fractional part) and allowed him to practise each step separately, he might never have learned the concept.

Before you assign workbook pages, verify that all students have the skills they need to complete the work.

Before assigning a question from one of the JUMP workbooks, it is important to verify that all of your students are prepared to answer the question without your help (or with minimal help).

Never allow students to work ahead in the workbook on material you haven't covered with the class.

Students who finish a worksheet early should be assigned bonus questions similar to the questions on the worksheet or extension questions from the teacher's guide. Write the bonus questions on the board or have extra worksheets prepared and ask students to answer the questions in their notebooks or on the worksheets. While students are working independently on the bonus questions, you can spend extra time with anyone who needs help.

Raise the bar incrementally.

When a student has mastered a skill or concept, raise the bar slightly by challenging them to answer a question that is only incrementally more difficult or complex than the questions previously assigned.

Praise students' efforts.

We've found the JUMP program works best when teachers give their students a great deal of encouragement. Because the lessons are laid out in steps that any student can master, you'll find that you won't be giving false encouragement. One of the reasons that kids love the program so much is that it's a thrill to be doing well at math!

Teach the number facts.

It is a serious mistake to think that students who don't know their number facts can always get by in mathematics using a calculator or other aids. Trying to do mathematics without knowing basic number facts is like trying to play the piano without knowing where the notes are. (See the Mental Math section of this guide for strategies to help students learn their number facts.)

Create excitement about math.

Engaging the entire class in lessons is not simply a matter of fairness; it is also a matter of efficiency. While the idea may seem counterintuitive, teachers will enable students who learn more quickly to go further if they take care of the students who struggle. Teachers can create a real sense of excitement about math in the classroom simply by convincing struggling students that they can do well in

the subject. The class will cover far more material in the year and students who excel will no longer have to hide their love of math for fear of appearing strange or different.

8. How to Create Bonus Questions

Students love to show off to their teachers by solving difficult-looking puzzles and surmounting challenges, and they also love to succeed in front of their peers. You can make math lessons more exciting (and also make time to check the work of students who need extra time) if you know how to create engaging bonus questions. Bonus questions generally shouldn't be based on new concepts and they don't have to be extremely difficult to capture the attention of students. Here are some strategies you can use to create questions that will look hard enough to interest students who work quickly, but that all of your students can aspire to answer.

1. Make the numbers in a problem larger or introduce several new terms or elements without introducing any new skills or concepts.

This is the simplest way to create bonus questions. Kids of all ages love showing off with larger numbers or with more-challenging looking rules and procedures. If your students know how to add a pair of three digit numbers without regrouping, let them impress you by adding a pair of five or six digit numbers. If they can add two fractions let them add three or four. You will be amazed at how excited students become when they can apply their skills with larger numbers or more difficult-looking calculations. You can use this strategy in almost any lesson.

Some things to bear in mind: First, bonus questions shouldn't look tedious. You don't want to give students an endless series of calculations that appear to have no purpose. It helps if you are excited when you assign bonus questions and if you assign only a few questions at a time. Students should feel they are involved in a quest, faced with a series of increasingly more difficult challenges that they believe they can meet.

Students will not necessarily gain a deeper conceptual understanding of a particular mathematical idea when they work on bonus questions that involve larger numbers or that have more terms or elements. But they will still make important conceptual gains. In addition to generalizing from smaller to larger numbers, they will, for instance, develop the ability to hold more material in their working memory, to follow a series of steps in a procedure, to stay on task, and to see patterns and apply rules in increasingly complex situations. They will also consolidate their understanding and commit the material memory. Their behaviour, confidence, and level of engagement will also likely improve.

2. Make a mistake and ask your students to correct it.

Students love correcting a teacher's mistakes—and you can find a way to make mistakes in any lesson! For instance, if you are teaching T-tables, you might draw the following T-table on the board:

INPUT	OUTPUT
1	7
2	10
3	14
4	16

Tell your students you created the table by adding the same number repeatedly to the initial number, but you think you made a mistake. Ask them to find the mistake and explain where you went wrong.

3. Leave out several terms or elements in a sequence and ask your students to say what is missing.

For instance, you might ask students to say what numbers are missing in the following T-tables, assuming the tables were made by adding the same number repeatedly. **NOTE:** The problem on the right is harder than the one on the left. Students might solve the problem on the right by guessing and checking or using a number line.

INPUT	OUTPUT
1	8
2	
3	14
4	17

INPUT	OUTPUT
1	7
2	
3	15

When you create bonus questions, use number facts that your students are likely to know and give clear and concise instructions. Rather than giving lengthy explanations to struggling students, try to assign tasks that students can immediately see how to do. For instance, if the numbers in the charts above are too difficult for your students, use different numbers:

INPUT	OUTPUT
1	2
2	4
3	
4	8
5	10

INPUT	OUTPUT
1	5
2	
3	
4	20
5	25

Most students know how to count by twos or fives, so every student should see which numbers are missing from these charts. Once struggling students have succeeded with easier tasks, they will be more willing to take risks and to guess and check to solve more difficult problems.

4. Vary the task or problem slightly.

You could use more challenging patterns in the output column, such as decreasing patterns (as shown on the left) or patterns with a gap that changes (as shown on the right).

INPUT	OUTPUT
1	23
2	20
3	17
4	14

INPUT	OUTPUT
1	5
2	7
3	10
4	14

You could also add an extra column to the table, as you might do if you were following a recipe with three quantities that vary with each other. You could ask students to say how much of one ingredient they would need if they had a certain amount of another ingredient.

Number of pies	Number of cups of flour	Number of cups of cherries
1	2	3
2	4	6
3	6	9
4	8	12

5. Look for applications of the concepts.

You might tell students that the numbers in the output column represent a student's savings and ask them to predict how long it will take to save a certain amount of money. Or you could give them a T-table and ask them to draw a picture or describe a pattern that might be represented by the table.

6. Look for patterns in any work you assign, and ask students to describe the patterns.

For example, if you ask students to find and state the rule for the T-table below, you can ask students who finish early to describe the pattern in the ones and the tens digits of the numbers in the right-hand column.

INPUT	OUTPUT
1	7
2	12
3	17
4	22
5	27

(Answer: the ones digit repeats every second term (7, 2, 7, 2, 7,…) and the tens digit increases by 1 every second term (0, 1, 1, 2, 2,…). This happens because the numbers increase by 5 each time, so after two steps they have increased by 10.)

This kind of exercise can keep students who finish their work early occupied while you do a spot check on other students' work.

7. Use extension questions from the teacher's guides.

As your students become more confident you will want to create questions that challenge them more and that extend the ideas in the lesson. Our lesson plans contain many suggestions for creating extension questions for your students.

9. Features of the JUMP Math Materials

Diversity of representation

What makes sense to one student does not always make sense to another. Students learn in different ways. Multiple representations help to reach a broader number of students. Students who see multiple representations of a concept also develop a deeper understanding of that concept and are better able to explain it. They can then begin to make connections between the various representations. The more ways you as a teacher know how to teach a concept, the better you will understand it yourself and the more able you will be to teach it in ways that meet the varying needs of your students.

Differentiated instruction

Because the math is broken into steps in the workbooks, the workbooks allow you to teach to the whole class while still addressing the needs of individual students (not leaving anyone behind and challenging those who are ready to move ahead). Part of the philosophy of JUMP Math is to teach to the collective—to ensure that the class meets success as a whole, thereby increasing excitement and momentum. On the JUMP Math worksheets, concepts and skills are introduced one step at a time, with lots of opportunities for practice. Struggling students can complete all of the questions on

a worksheet while students who excel can skip some questions and do extra work provided in the teacher's guides.

Text and layout

In the workbooks, we tried to reduce the number of words per page and to use clear, simple language. This ensures that all students have equal access to the materials, regardless of their reading level. (However, in the teacher's guides you will find many exercises that combine mathematics with language learning and communication.) Layout is simple and uncluttered to avoid distraction, which is particularly helpful for children with learning disabilities. Visual elements such as boxes, figures, background shading, and bold text emphasize changes in content to help students learn new steps or new ideas.

Review in the workbooks

At the beginning of the school year, teachers often find that many of their students have forgotten material taught in the previous year. That's why the workbooks for each grade level (after Grade 1) provide review that goes back one or two years in the curriculum. Research in education has shown that if teachers assess their students and start at the right level, they cover more curriculum in the year.

10. Hints for Helping Students Who Have Fallen Behind

Teach the number facts.

Struggling students often have a weak grasp of number facts. They have trouble solving problems or doing calculations because their working memories are overwhelmed trying to recall number facts. Research shows that automatic recall of number facts helps enormously in the learning of math.

Give cumulative reviews.

Even mathematicians constantly forget new material, including material they once understood completely. Giving reviews doesn't have to create a lot of extra work for a teacher. John Mighton recommends that, once a month, you copy a selection of questions from the workbook for units already covered onto a single sheet and make copies for the class. Students rarely complain about doing questions they already did a month or more ago (and quite often they won't even remember that they did those particular questions).

Make mathematical terms part of your spelling lessons.

In some areas of math (e.g., geometry) the greatest difficulty that students face is in learning the terminology. If you include mathematical terms in your spelling lessons, students will find it easier to remember the terms and to communicate about their work.

Set aside five minutes every few days to give extra review to struggling students.

Spending five minutes with a small group of students who need extra help can make the teaching component of lessons more productive. Ensuring that struggling students have the prerequisite skills and knowledge to participate fully in the lesson will enhance their learning and contribute to a positive learning environment for all your students.

Allow wait time.

Wait time is the time between asking the question and soliciting a response. Wait time gives students a chance to think about their answer and leads to longer and clearer explanations. It is

particularly helpful for more timid students, students who are slower to process information, and students who are learning English as a second language. Studies about the benefits of increasing wait time to three seconds or longer confirm that there are increases in student participation, better quality of responses, better overall classroom performance, more questions asked by students, and more frequent and unsolicited contributions.

11. Other Features of the JUMP Math Program

1. Professional Learning

Teachers

Training sessions offered across Canada give teachers opportunities to:

- Learn about JUMP Math's philosophy and guiding principles
- Consider their own comfort levels with mathematics and math instruction
- Watch a video of a lesson and discuss specific instructional techniques
- Learn how to use all of the JUMP Math resources
- Take home practical ideas on how to support all students' learning in the classroom

Community Volunteers

A new JUMP Math Essentials tutor program (Grades 3–8) is now available. There are three resource packages: Grades 3 & 4, Grades 5 & 6, and Grades 7 & 8. Each package includes a detailed tutor's guide and student worksheets. Detailed information is available at www.jumpmath.org.
Training sessions for tutors include instruction on how to:

- Plan for 25 weeks of lessons
- Assess student requirements
- Engage students and get them excited about math
- Use the support materials

2. National Book Fund

JUMP Math is committed to supporting vulnerable communities in schools. We provide free resources and supports through the National Book Fund.

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