ISSN 1481-7799 **Spring/Summer 2020**

President's Message

As your incoming MTA president, I look forward to working on your behalf with the executive to deliver on the association's objectives for the upcoming year. Having been involved with the MTA for six years in numerous capacities, I continue to be impressed by the work of my executive colleagues, who commit their time and expertise so that the association's primary objective - the annual MTA conference - inspires participants and provides practical tools and approaches that can be applied in the classroom. As the situation with the COVID-19 pandemic evolves, your executive is looking at options for ensuring the Fall conference can be effectively delivered to you. We will share more information as it becomes available. In the interim, thank you for the ongoing support you are providing to your students so that, despite these challenging times, they have a successful conclusion to their school year. Have a good summer and stay safe.

Zeno MacDonald
President
Mathematics Teachers Association

NOVA SCOTIA
MATHEMATICS
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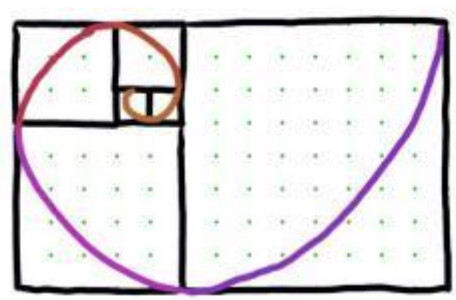
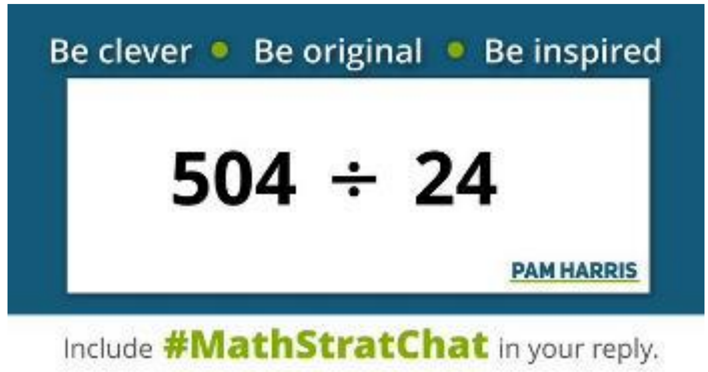
In This Issue



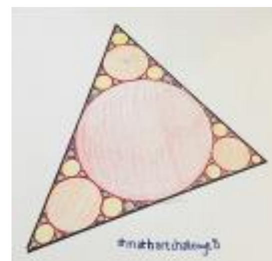
A Golden Spiral for #mathartchallenge from Annie Perkins on Twitter (see page 2)

Math in the News and Around the Web

#MathStratChat from Pam Harris - Each week, Pam Harris (@pwharris) posts a question prompt on Twitter. You can access this chat using the hashtag #MathStratChat (note that you don't need a Twitter account to do this). Each week, educators join in the discussion and share interesting strategies. You might see a strategy that you've never encountered before or make a connection that you hadn't considered. How would you evaluate the expression at right? Once you've given it some thought, check out the strategies that have been shared on Twitter: https://twitter.com/pwharris/status/1258203960449609728



Math-Art Challenge — Annie Perkins (@anniek_p) has been hosting the #mathartchallenge on Twitter during this time of physical distancing. Each day she posts a description of a project or activity to spur your creativity. She started this project in mid-March and plans to continue with daily activities for 100 days. All of the projects are archived on her website at https://arbitrarilyclose.com/home/ for you to explore.



Mathematical Games — Games can be a great way to engage students in practicing mathematical skills. The best classroom games have several characteristics in common: they have mathematics as the engine of the game, they are easy to learn and quick to play, and they require inexpensive or commonly found materials. Here are some great sites to find high quality games:

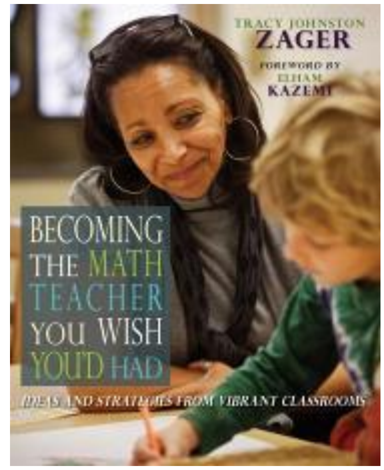
- Dan Finkel, the creator of Tiny Polka Dot and Prime Climb, has an amazing list of games on his website at: https://mathforlove.com/lesson-plan/games/
- Games for Young Minds is a website with reviews of tons of different games curated by math teacher Kent Haines at: https://www.gamesforyoungminds.com/
- Math Pickle is a website from Dr. Gordon Hamilton, a mathematician and game designer. This website hosts a fantastic array of mathematical puzzles and games. My favourites include Aggression and Mondrian Art Puzzles. Check out the entire website at: https://mathpickle.com/

Nova Scotia Provincial Assessment Lessons Learned Grades 3, 6 and 8 — The EECD has released updated grade 3, 6 and 8 mathematics lessons learned documents. These document specifically address areas that students across the province found challenging based on provincial assessment evidence. Suggested next steps for classroom instruction and assessment are included for each Lesson Learned. Links to these documents are on the Program of Learning Assessment for Nova Scotia (PLANS) website:

Grade 3: http://plans.ednet.ns.ca/sites/default/files/documents/M3-EN_LessonsLearned%2802-20%29.pdf
Grade 6: http://plans.ednet.ns.ca/sites/default/files/documents/M8-EN_LessonsLearned%2802-20%29.pdf
Grade 8: http://plans.ednet.ns.ca/sites/default/files/documents/M8-EN_LessonsLearned%2802-20%29.pdf

Math in the News and Around the Web

Becoming the Math Teacher You Wish You'd Had by Tracy Zager -



Tracy Zager was our keynote speaker at the MTA Annual Conference in October, 2019. While attending the conference, Tracy signed and donated a copy of her book. [Find more information about her book at the Stenhouse website](https://www.stenhouse.com).

Would you like a copy of this book?

Fill out this Google Form prior to **June 30th** for a chance to win this signed copy! https://forms.gle/g18urVA8N17TRPFQ8

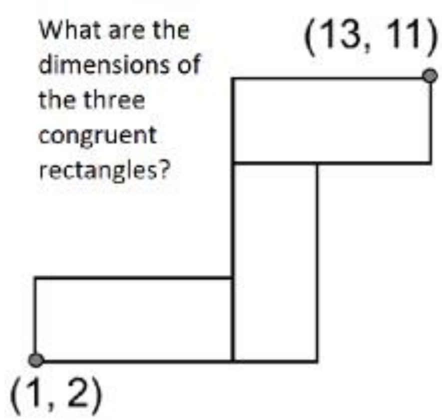
In Memory of Don Steward — Don Steward, a mathematics teacher from the United Kingdom, passed away during the first week of May 2020. He will be sadly missed by all in the mathematics education community. He inspired both students and teachers think deeply about mathematics. Don regularly posted on his blog for over a decade. He created a treasure trove of mathematics problems and resources and shared them freely at his site, https://donsteward.blogspot.com/. Don requested and made arrangements for his blog to remain freely available for all to access. Below are just a few of his many problems.

Mini—Times Table

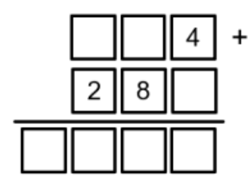
Fill in the missing numbers

×	9			
2				
		28		35
		24	18	
		32		

What are the dimensions of the three congruent rectangles?



all the digits 0 to 9 are used, each used once only, in the sum



2, 4 and 8 are placed as shown

find where to place the remaining seven digits

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FOLLOW US ON twitter

https://twitter.com/MTA_NS

News from Conseil scolaire acadien provincial

Le CSAP avait établi plusieurs buts en numératie pour l'année scolaire 2019-2020 et les enseignants de mathématiques et les spécialistes en mathématiques les ont travaillés tout au long de l'année.

Le premier but travaillé par les enseignants était de comment utiliser la communication orale pour permettre des moments stratégiques où faire parler les élèves dans une leçon mathématique. Les enseignants offrent plusieurs d'occasions aux élèves de communiquer oralement tout en utilisant un vocabulaire correct en mathématique. La communication orale permet aux enseignants à la fois de vérifier les acquis par rapport à divers concepts mathématiques ainsi que des stratégies pour appuyer l'apprentissage de leurs élèves les élèves.

En plus, les enseignants travaillent à incorporer davantage le matériel de manipulation lors des activités d'apprentissage afin de développer un meilleur sens du nombre et d'autres concepts mathématiques chez les élèves. Les recherches démontrent clairement que l'utilisation du matériel concret est nécessaire pour permettre aux élèves de pouvoir passer d'une représentation concrète à une représentation imagée et éventuellement à une représentation symbolique. Les enseignants utilisent toutes les occasions possibles pour inclure du matériel de manipulation lors des activités d'apprentissage avec les élèves. Il est vrai que les enseignants utilisent déjà différents matériels de manipulation lors des activités d'apprentissage, mais il y a toujours eu des occasions de se servir de ce matériel de plus en plus avec les élèves.

Les rapports *Leçons apprises* contiennent les analyses des résultats des évaluations provinciales à différents niveaux. Ces rapports indiquent que la résolution de problèmes est un élément difficile pour nos élèves. Afin de mieux rencontrer les besoins de nos élèves, le CSAP a établi un comité pour la création d'une trousse pédagogique en résolution de problèmes en mathématiques de la 4^{e} à la 6^{e} année. Cette trousse contient des outils qui permettent aux enseignants de situer l'élève par rapport aux quatre composantes de la résolution de problèmes : ressortir les informations importantes; les représentations concrètes, imagées et symboliques; ainsi que la communication de la solution. Ces outils permettent à nos enseignants d'utiliser la trousse comme un outil au service de l'apprentissage afin de situer les forces et les besoins de leurs élèves, ainsi que de guider les prochaines étapes de leur enseignement.

Finalement, l'équipe mathématique continue d'appuyer l'intervention mathématique. Les membres de l'équipe mathématique ont travaillé avec les intervenants et intervenantes qui travaillent directement avec des élèves pour les aider à cheminer en mathématiques par rapport au domaine du nombre. Les membres ont partagé avec les intervenants des pratiques gagnantes et des stratégies qui favorisent l'apprentissage qui ont permis aux élèves de progresser. Ils ont utilisé entre autre un format de co-enseignement, ce qui a permis non seulement de faire cheminer les élèves, mais qui a permis aussi aux enseignants de travailler ensemble pour maximiser l'impact de leur intervention auprès des élèves. Travailler en équipe a permis d'établir des liens professionnels entre les enseignants et les intervenants.

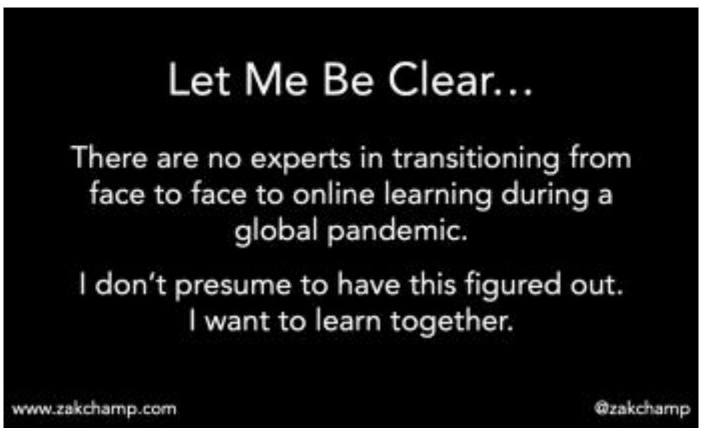
Le CSAP est très reconnaissant de tout le travail que font nos enseignants, et tout autre personne qui travaille de près avec les élèves pour les appuyer dans leur cheminement mathématique ainsi que les membres de notre équipe de mathématiques. Nous avons confiance que toutes ces initiatives vont certainement aider TOUS nos élèves à cheminer en mathématiques.

Remote Learning Update

By Zak Champagne (@Zakchamp), Past-President of the Florida Council of Teachers of Mathematics (@FCTMath). Reprinted with permission from http://www.zacharychampagne.com/blog/2020/4/16/remote-learning-update

We're nearly a month in to our remote learning. It seems like two days and two years ago at the same time. I've come a long way in what I now think I know and understand about this work. But, there are still so many things to understand and make sense of. I am so grateful for the communities (both those at my school site and my virtual ones) who continue to push my thinking and make a better experience for our students.

So…this week I was honored to lead a webinar on how I'm navigating this new normal. I lead with this thought.



I wanted to be open and honest that I don't, and I hope no one does, presume to have this figured out. I've tried some things with my team, and some of them are working and my hope is that we'll all share what we're learning with each other.

So here we go.

There are three guiding principles that I think we should keep in mind as we learn to do this work.

There is no one "right" way to do this.

We ALL have specific circumstances, barriers, and structures that are unique to our students and families. There is not one way that works for all. We are all doing the best that we can.

Connection is fundamental to engagement.

We must remember that if students don't feel connected to something (you, their classmates, the content, etc…), they are going to struggle to engage in the work. So, if we do nothing else during this time, let's make sure our kiddos feel connected.

Use a minimum amount of technology to accomplish your goals.

Start with what you want to accomplish. Then decide what is the minimum amount of tech that can support this work. This will help keep things more equitable. It won't solve the whole issue. But, it can help.

With these principles in mind, these guiding questions are ones that I believe are critical to explore as you build your plan moving forward.

- *Do you have flexibility in how you structure this work?*
- *How can you keep the tech simple?*
- *Will this be synchronous or asynchronous? Or a combination?*
- *What about parents? How can you engage them? How can you make this easier for them?*
- *What barriers are in place to keep this from happening? How can you work around them?*
- *Are you introducing new content?*
- *How and what do you want to assess?*

And finally, here are some suggestions you might want to consider. I don't pretend this list is exhaustive. I offer them here as things that seem to be working for me.

- *Assign "must do" and "can do" problems.*
- *Suggest headphones for students (when available).*
- *Don't let tech be a barrier to connecting with your students (use phone, email, text to let them know you are thinking of them and you are there if they need you)*
- *Leverage existing routines (number of the day, calendar, solve and share, etc.)*
- *Include "real world" math (How Many, WODB, Math Photo Challenge, Notice/Wonder, etc.)*

Remote Learning Update By Zak Champagne

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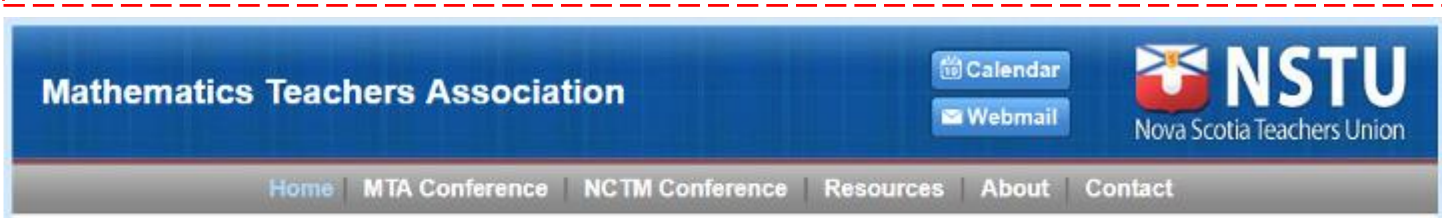
That's enough for now. There's much more detail in the webinar. So, if you are interested, you can download my slide deck here. Or you can watch a recording of the K-5 session here and the 6-8 session here.

There are so many of us doing this work right now, and I want to learn together. So, I hope that we can continue to share what's working and what's not. We all get better when we're in this together. Much love everyone. We've got this!

A Collection of Remote Learning Resources

- EECD has created an eLearning Support website with ideas for planning and appropriate online tools at https://curriculum.novascotia.ca/teacher-information. Teachers are asked to check this site often as new resources are being added.
- The 2020 Euclid (Grade 12), Fryer (Grade 9), Galois (Grade 10) and Hypatia (Grade 11) mathematics contests (which were cancelled) from the Centre for Education in Mathematics and Computing (CEMC) are now available online. https://cemc.uwaterloo.ca/contests/past_contests.html. These are valuable enrichment problems for students who are looking for a mathematical challenge at home.
- Also from CEMC are online courseware (https://cemc.uwaterloo.ca/resources/courseware/courseware.html) including high quality videos and practice problems for students in grades 7-12. For grades 9-11, courses have been aligned to Nova Scotian outcomes using a curriculum map (https://cemc.uwaterloo.ca/resources/courseware/grade-9-10-11-curriculum-maps.html).
- The Desmos free online graphing calculator (https://www.desmos.com/) can be a powerful tool for students who do not have a handheld graphing calculator of their own while at home. Additionally valuable for teachers during distance learning are Desmos Activities. Desmos has added many new features to make using this from home more useful. One such new feature is the online feedback too. For details of these features or webinars on how to use Desmos activities, visit https://learn.desmos.com/coronavirus. For collections of Desmos activities aligned to grades 7-12 Nova Scotia math courses visit https://pbbmath.weebly.com/blog/desmos-collections.
- The Newfoundland and Labrador English School District (NLESD) has online resources for grades 7-12 math courses. The can be access from their website https://www.nlesd.ca/index.jsp. Once on the website, select the program menu and then Mathematics to select the course you are interested in.



Nova Scotia Mathematics Teachers Association Website

Have you visited the NS MTA website recently? This is your source for information on the NS MTA conference, NCTM conferences and resources including math websites, enrichment, math contests and past issues of this newsletter. Check it out at http://mta.nstu.ca/

Emphasizing Dimensions with Partial Scalings

By Nat Banting (@NatBanting), Faculty in the Department of Curriculum Studies, University of Saskatchewan & Saskatoon Public Schools classroom mathematics teacher. Winner of the 2019 Rosenthal Prize for Innovation and Inspiration in Math Teaching.

Scale factor outcomes exist across several secondary grades in the Western and Northern Canadian Protocol curricular framework (Alberta Education, 2006, 2008), a framework shared by many provinces including both Nova Scotia and my home province of Saskatchewan. In Mathematics 9, students are asked to demonstrate scale factor proficiency with two-dimensional (2-D) objects by determining a scale factor, using a scale factor to find dimensions, and creating scale diagrams. Even though the mathematical objects are in two dimensions, the students really only work in one dimension at a time, applying the scale factor (typically denoted by the variable, k) to the sides of shapes one at a time. The study of scale factor culminates in Mathematics 11, when students are introduced to the web of relationships between scale factors—plural. Not only does the outcome now include three-dimensional (3-D) shapes, it requires that students now consider the scale factor between the areas of scaled 2-D objects (k^2), the scale factor between the surface areas of scaled 3-D objects (also k^2), and the scale factor between the volumes of scaled 3-D objects (k^3). None of these are explicitly considered when working with 2-D shapes in Mathematics 9, establishing a rapid scaling in sophistication—one that I have consistently found to be of great difficulty to learners.

For years, my typical response to this challenge was to establish the notion of a 2-D scale factor before introducing the notion of a 3-D scale factor. This progression, mirrored by our textbook, was done through a series of prompts that began with having students draw simple 2-D shapes, use their knowledge of scale factor (k) to double (k = 2) or triple (k = 3) a diagram, and then compare the resulting areas. The 2-D relationship was established before the activities were repeated using linking cubes to build scaled 3-D objects. Despite my insistent efforts, the notion that the 2-D scale factor (k^2) really was the multiplication of two, one-dimensional (1-D) scalings (i.e. $k \bullet k$) never seemed to stick, and neither did the 3-D equivalent. This led to, at best, procedural mastery of the concept and, at worst, widespread confusion.

If you look through the prompts you provide to students, my guess is that they are a lot like mine. That is, I am willing to bet that they have a particular characteristic in common: they all talk about a perfect scale model or diagram. It is no wonder that students lose the notion of dimensions composing the scale factor when they are only ever presented the case when each dimension (be it 2-D or 3-D) is scaled the exact same amount. Nowhere are they asked to investigate what would happen if certain dimensions were scaled differently than others, or, in the special case I will present here, certain dimensions are scaled while others are left unaltered (i.e. k=1). I contend that

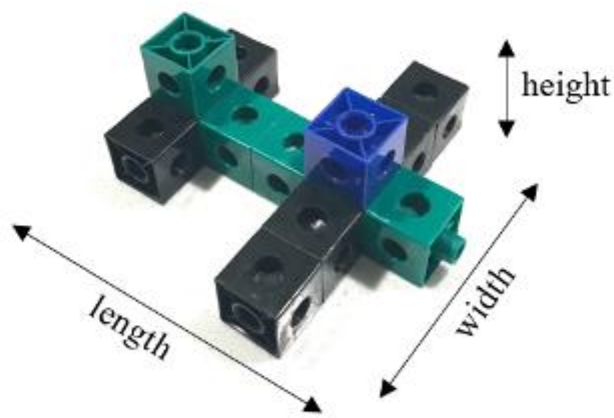


Figure 1: An original linking cube airplane.

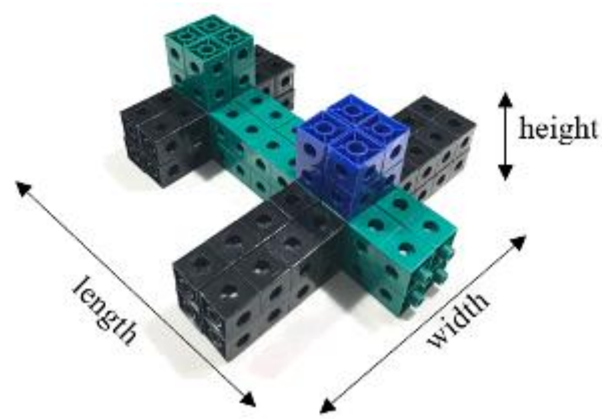


Figure 2: A scale model of the same linking cube airplane (k = 2).

Emphasizing Dimensions with Partial Scalings by Nat Banting

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applying a scale factor to a single dimension at a time and creating a series of "partial scalings" emphasizes the impact of each, individual dimension. The relationship between the areas or volumes of the objects can then be seen as the result of separate 1-D scalings.

Here, we will focus on a 3-D example by considering a simple 3-D model of an airplane constructed out of linking cubes (Figure 1) and a second, scaled model of the same airplane using a scale factor of $k = 2$ (Figure 2).

The second model was created by doubling (i.e. applying a scale factor of $k = 2$) each of the three dimensions (length, width, and height). The result is an object that is exactly the same shape, but has increased in size. Actually, three different, yet intertwined, qualities have increased in size. The linear measurements (a 1-D feature) have all increased by a factor of 2, the surface area (a 2-D feature) has increased by a factor of 4, and the volume (a 3-D feature) has increased by a factor of 8. And while this scale model provides a possible entry case into the phenomenon, consider, again, the same model after a partial scaling where only the width of the airplane is doubled (Figure 3).

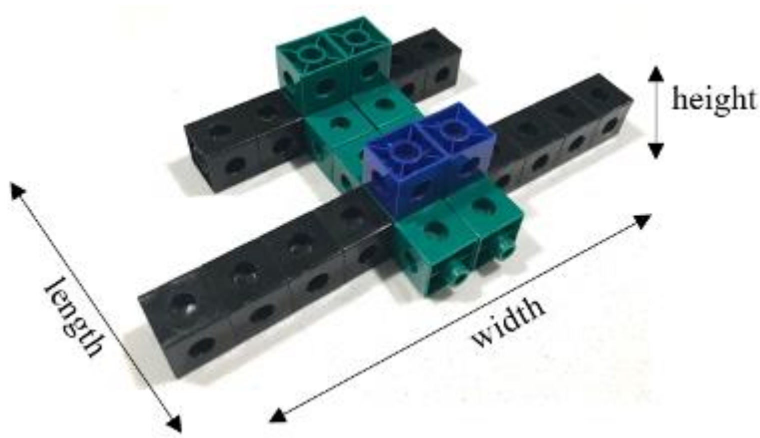
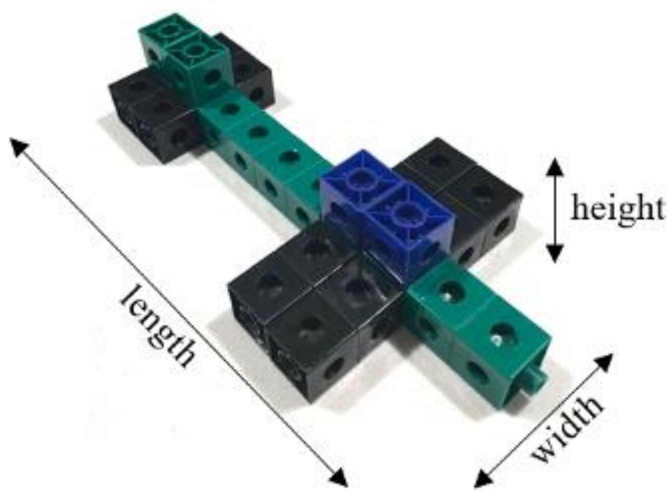


Figure 3: A partial scaling of the airplane where $k = 2$ is applied only to the width.

Deconstructing this airplane uncovers some interesting characteristics. First, the volume of the plane in Figure 3 is exactly double the plane in Figure 1. In other words, it uses exactly twice as many cubes. Because we only scaled the width, it is fairly straightforward to see how each cube became two cubes in the new plane. This doubling can be directly attributed to the dimension that was doubled (in this case, width), strengthening the conceptual relationship between a scale factor applied to specific dimensions and the result on the object's volume as a whole. In fact, we if we isolated the two other dimensions (length and height) for partial scaling, both would contain exactly double the cubes as the original (Figure 4).

This partial scaling shown in Figure 3 also provides an interesting analysis into the relationship between the di-



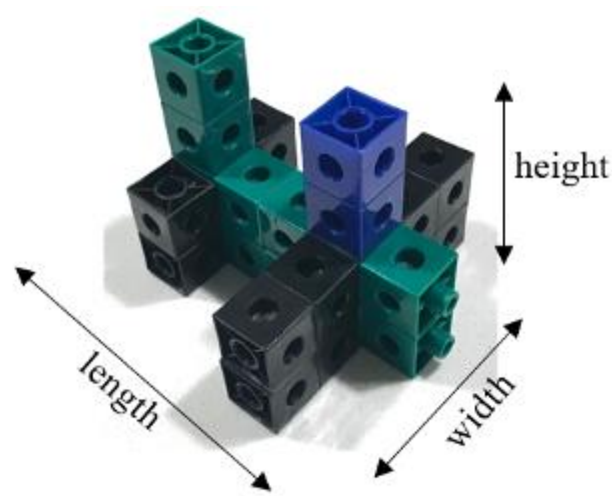


Figure 4: Partial scalings where $k = 2$ is applied only to the length (left) and height (right).

Emphasizing Dimensions with Partial Scalings Nat Banting

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mensions and the surface areas of the two planes. We can confirm, by counting, that that the surface area of the new plane was not also doubled. The original plane had a surface area of 34 units^2 and the new, partially-scaled plane has a surface area of 54 units^2. While it appears like there is no obvious relationship between these two numbers, a doubling does reveal itself under closer inspection. Only the faces affected by doubling the width of the object have been doubled in area, and we can employ a strategic method for counting the surface area in order to see this impact of the partial scaling.

First, we separate the surfaces of the plane into six general categories: front-facing, back-facing, top-facing, bottom-facing, left-facing, and right-facing. For each category, determine the total surface area of the plane's faces that orient in that specific direction. For example, the front-facing surfaces of the original plane total 9 units^2 of surface area; we can count this by imagining we are looking straight into the propeller of the plane, and counting every face oriented in the same direction. The bottom-facing surfaces of the same plane total 11 units^2 of surface area; we can count this by imagining we are lifting the plane up and counting every cube that has an exposed bottom side. If we continue this process for all six orientations for both the original plane (Figure 1) and the partially-scaled plane (Figure 3), we arrive at the surface areas in Table 1.

While the total surface area was not doubled under this partial scaling, looking horizontally across Table 1 reveals that four of the six categories do double in surface area when the width alone is doubled. Each front-facing surface of the airplane is doubled because the area of each front-facing surface can be calculated by multiplying a width by a height. Because the width has been doubled (k = 2), the area of each front-facing surface has also been doubled.

Category	Dimensions to Calculate Area	Original Airplane (Figure 1)	Partially-Scaled Airplane (Figure 3)
Front-facing	width x height	9 units^2	18 units^2
Back-facing	width x height	9 units^2	18 units^2
Top-facing	length x width	11 units^2	22 units^2
Bottom-facing	length x width	11 units^2	22 units^2
Left-facing	length x height	7 units^2	7 units^2
Right-facing	length x height	7 units^2	7 units^2
TOTAL		*34 units^2*	*54 units^2*

Table 1: The surface areas of each category for both the original and the partially-scaled airplane.

The same goes for the back-facing surfaces, which are also calculated by multiplying a width by a height. The area of both the top-facing and bottom-facing surfaces can be calculated by multiplying a length by a width. Because the width has been doubled (k = 2), the area of each top-facing and bottom-facing surface has also been doubled. The pattern is broken by the left-facing and right-facing surfaces. The area of these faces can be calculated by multiplying a length by a height. Because both of these dimensions are unchanged in the partial scaling, so is the total surface area of these categories.

Analyzing objects that are partial scalings (before introducing perfect scale diagrams or models) can place a focus on the relationship between the scale of specific dimensions of an object and the effect the object's area, surface area,

Emphasizing Dimensions with Partial Scalings Nat Banting

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or volume. As Table 1 shows, the doubling phenomenon that existed between the volumes of the two airplanes does exist between the surface areas as well, but only on the surfaces involving the affected dimension—which, in this case, was the width. Such a realization begins to tether any proportional change in surface area or volume directly to the proportional change in specific dimensions, with the special case eventually becoming the case where all three dimensions are scaled by the exact same factor.

References

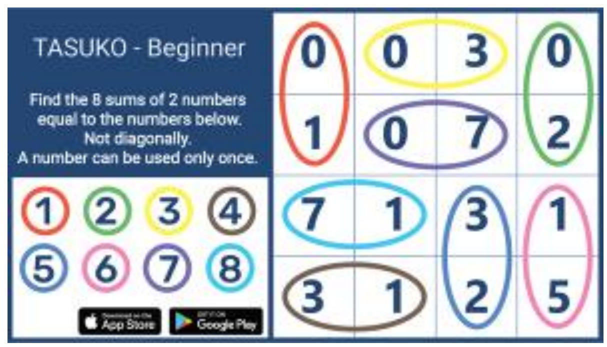
Alberta Education. (2006). Common curriculum framework for K-9 mathematics: Western and northern Canadian protocol. Edmonton, AB: Alberta Education.

Alberta Education. (2008). Common curriculum framework for 10-12 mathematics: Western and northern Canadian protocol. Edmonton, AB: Alberta Education.

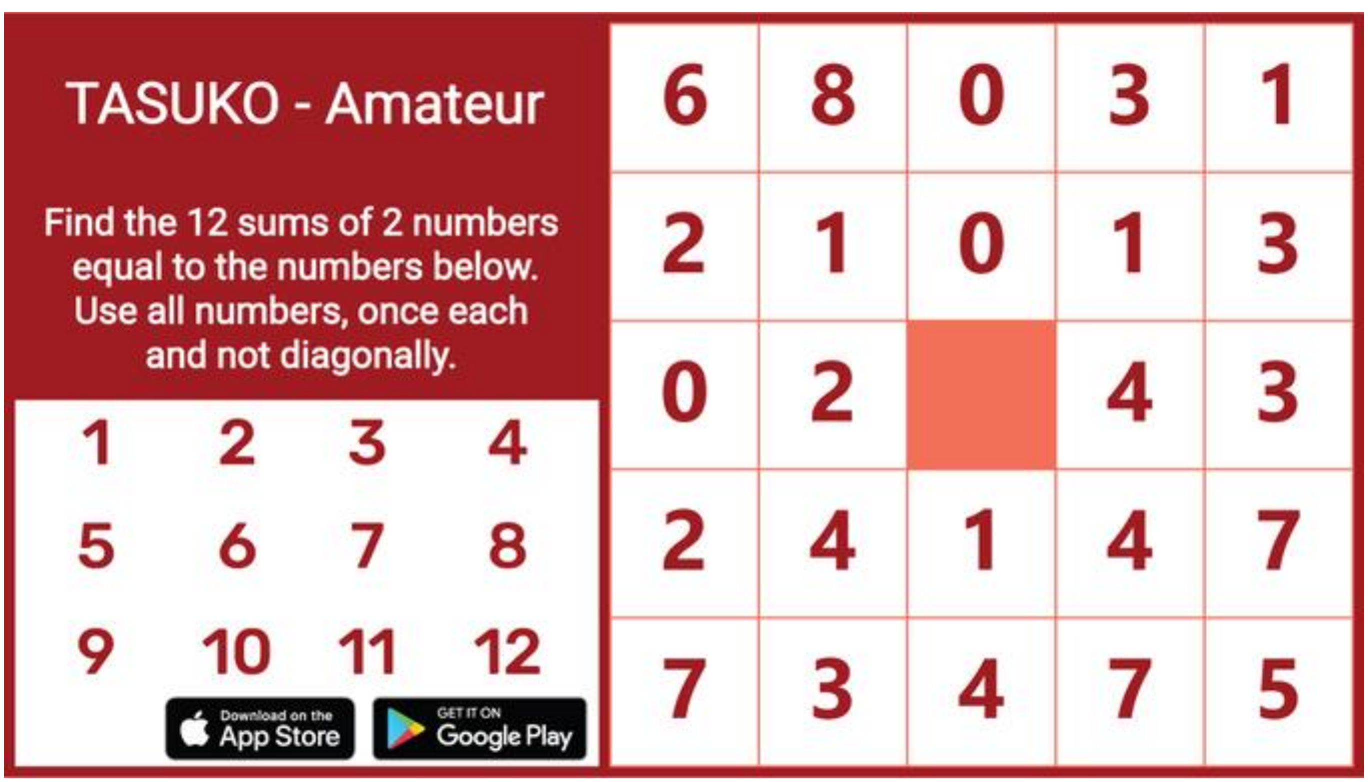
Adventures in Logic and Reasoning

The Tasuko Game

The Tasuko game (@Tasuko_Game) is a logic puzzle where you are challenged to find pairs of adjacent numbers in a grid to match with a list of target sums. The author of these puzzles, Olivier Semenec, regularly posts puzzles on Twitter of various levels of complexity, from the amateur level game below to "Diabolical" difficulty. The puzzle is also available as an app on both IOS and Android.



A completed game with eight pairs of sums.



Tasuko game printed with permission from Olivier Semenec.

Nova Scotia Math Teachers Association Executive

Below are the current members of the NS MTA Executive. The membership and the positions of the executive change each year at the Annual General Meeting held at the MTA Provincial Conference (The MTA provincial conference is on the fourth Friday in October of each year).

Name	Position	Contact
Zeno MacDonald	President	zgmacdonald@nstu.ca
Erick Lee	Vice-President/Communications	eplee@nstu.ca
Joe MacDonald	Past President	jamacdonald@nstu.ca
David MacFarlane	Treasurer	sdmacfarlane@nstu.ca
Anne Pentecost	Secretary	adgrenier@nstu.ca
Jennifer Courish	Member-at-Large Chignecto	courishjl@nstu.ca
Kimberley McCarron	Member-at-Large Cape Breton	kamccarron@nstu.ca
Maureen MacInnis	Member-at-Large Halifax	mjmacinnis@nstu.ca

Special Projects

The MTA strives to give back to its membership by making funding available for special projects developed by classroom teachers. If you have an innovative math education project taking place in your classroom(s), MTA may be able to offer some financial assistance to help develop the project. Information on funding can be obtained by contacting any member of the Executive.

Call for Contributions

We are better together. Mathematics Matters, the MTA newsletter, is looking for a variety of contributions from elementary and secondary teachers, math mentors and coaches, math support teachers and others who are interested in the teaching and learning of mathematics. Please consider sharing a favorite lesson or activity, a reflection or blog post, a book or technology review, or another work of interest to mathematics teachers in Nova Scotia and beyond. Sharing your ideas and reflections with other teachers is a great way to contribute to a vibrant and dynamic community of mathematics educators in our province.

If you are interested in contributing, please contact me at eplee@nstu.ca. We look forward to hearing from you!

The MTA Newsletter is published by the NSTU for the Mathematics Teachers Association, Erick Lee, Editor.

The opinions expressed are not necessarily those of the Editor, the NSTU, or the MTA.