HOW WE ORGANISE OURSELVES

Attitudes and skills help organisations to solve problems and achieve their goals.

Within small-group organisations we will use attitudes and skills to solve Math problems. We will solve a number of small problems and one larger problem. However large or small a Math problem is, we can inquire to solve it by using our Problem Solving Steps with self-guiding questions.

UNDERSTAND → *PLAN* → *ACT* → *REFLECT*

We will learn how to structure our small-group organisations to achieve our goal to solve Math. We will also learn about how to make decisions within our organisations.

PROBLEM SOLVING STEPS

Inspired by Student Achievement Division of Ontario Schools and McGraw-Hill. Produced by Natasha Hutchins at www.prodivame.com

1 UNDERSTAND

Guiding Questions to Understand the Mathematical Task and its Context
What Math am I investigating?
What information am I going to use to solve this problem?
What is the goal of the procedure?
What sort of answer(s) should I expect?
How can I predict or estimate the outcome?
What questions would be useful to ask?
What does _____ mean?

EXPLORE
View/listen/read the problem carefully. Ask yourself questions like "What facts do I know?" and "What do I need to find out?"

Guiding Questions to Establish Connections and Activate Prior Knowledge
What other problem have I solved that is similar to this one?
What does this make me think of?
What other Math can I connect with this?
When do I use this Math at home? At school? In other places?
Where do I see _____ at school? At home? Outside?
What do these _____ have in common? What is unique about each of them?
How is this like something I have done before?

2 PLAN

Guiding Questions to Share Representations
How will I show my thinking (e.g., picture, model, number, sentence)?
Which Math words will I use to describe my experience?
How will I show your solution?
How would I explain _____ to a student aged _____?

Guiding Questions to Predict, Invent or Solve
What would happen if _____?
~~How else might I have solved the problem?~~
What are the steps?
How else could I do it?
How could I prove that?
How will I know my answer is reasonable?

PLAN
See how I've been connecting facts/ideas to each other. Make a plan for solving the problem. Estimate the answer.

3 ACT

Guiding Questions to Clarify Reasoning and Understanding
How do I know?
How do I know my answer is reasonable?

Guiding Questions to Focus on Communication
What could I add to my solution to make it clearer for the reader?
How can I represent my thinking?

Guiding Questions to Make a Conjecture
What would happen if _____?
Would this work every time? Can I think of any examples that don't work?

SOLVE
Use your plan to solve the problem. If your plan does not work, revise it or make a new one.

Guiding Questions to Reflect
What questions are arising as I work?

Guiding Questions to Share Representations
Which way (e.g., picture, model, number, sentence) best shows what I am finding?

4 REFLECT

Guiding Questions to Reflect, Clarify Reasoning and Understanding
What was my thinking when I made decisions or selected strategies to solve the problem?
What changes did I have to make to solve the problem?
What was the most challenging part of the task? And why?
How could I arrive at the same answer but in a different way?
How would I explain what _____ just said, in my own words?

Guiding Questions to Reason Mathematically
Have I found all the possibilities?
How do I know?

EXAMINE
Revisit the problem. Ask, "Is my answer close to my estimate? Does my answer make sense for the problem? If not, solve the problem another way.

Guiding Questions to Compare Solutions and Look for Commonalities
How is this solution similar to or different from the others?

Guiding Questions to Synthesise Learning and Articulate Generalisations
What have I discovered about _____ while solving this problem?
What have I learned today?

PROBLEM SOLVING TALK

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Show · Describe · Demonstrate · Represent

How have you shown your thinking (e.g., picture, model, number, sentence)?
Which way (e.g., picture, model, number, sentence) best shows what you know?
How have you used math words to describe your experience?
How did you show it?
How would you explain _____ to a student aged ___? (a year lower than the one the student is in)

Questions To Help Students **SHARE THEIR REPRESENTATIONS**

I decided to use a...
A graph (table, T-chart, picture) shows this the best because ...
I could make this clearer by using a ...
The math words that help someone understand what I did are ...

Contrast · Show · Test · Sort · Apply / **Classify · Analyze · Compare · Model · Survey**

What mathematics were you investigating? What questions arose as you worked?
What were you thinking when you made decisions or selected strategies to solve the problem?
What changes did you have to make to solve the problem?
What was the most challenging part of the task? And why?
How do you know? How does knowing _____ help you to answer the questions _____?

Questions To Help Students **REFLECT ON THEIR WORK**

A question I had was ...
I was feeling really ...
I decided to _____, I was thinking ...
I found _____ challenging because ...
The most important thing I learned in math today is ...

Connect · Relate · Refer · Imagine · Describe or Compare

What does this make you think of?
What other math can you connect with this?
When do you use this math at home? At school? In other places?
Where do you see _____ at school? At home? Outside?
How is this like something you have done before?

Questions To Help Students **MAKE CONNECTIONS**

This new math idea is like...
I thought of ...
I did something like this before when ...
We do this at home when we ...
I remember when we ...

Share · Reflect · Describe · Compare · Tell

What else would you like to find out about _____?
How do you feel about mathematics?
How do you feel about _____?
What does this math remind you of?
How can you describe math?

Questions To Help Students **SHARE THEIR FEELINGS AND ATTITUDES OR BELIEFS ABOUT MATHEMATICS**

The thing I like best about mathematics is ...
The hardest part of this unit on _____ is ...
I need help with _____ because ...
Write to tell a friend how you feel about what we are doing in mathematics.
Mathematics is like _____ because ... Today, I felt ...

TELL · LIST · RECITE · NAME · FIND / **DESCRIBE · EXPLAIN · ILLUSTRATE · SUMMARISE**

How did you solve the problem? What did you do?
What strategy did you use? What math words did you use or learn?
What were the steps involved?
What did you learn today?
What do(es) _____ mean to you?

Questions To Help Students **RETELL**

I solved the problem by ... The math words I used were ...
The steps I followed were ...
My strategy was successful because ...
Explain to a young child or someone that wasn't involved ...
Draw a picture to show how you solved the problem.

CREATE · PLAN · DESIGN · PREDICT · IMAGINE / **DEVISE · DECIDE · DEFEND · SOLVE · DEBATE**

What would happen if ...? How else might you have solved the problem?
How are adding and multiplying the same? What things in the classroom have these same shapes?
How is this pattern like addition? What would you measure it with? Why?
What decisions can you make from the pattern that you discovered?
Will it be the same if we use different numbers?

Questions To Help Students **PREDICT, INVENT OR PROBLEM SOLVE**

Prove that there is only one possible answer to this problem.
Convince me!
Tell me what is the same? What is different?
How do you know?

We will keep a Math Journal to help us think, record and discuss our learning. Reflection through thinking, recording and discussion is very important too and, to help us, we can use our special Problem Solving Talk group questions and discussion prompts.

As we solve small problems, we will use a special Math Assessment Rubric. This will help us know our level of Math achievement, Skill achievement and Attitude achievement. It also shows us what is expected and how to improve. This will give us plenty of practice developing our attitudes, skills and knowledge so we can solve our one larger problem.

PROBLEM SOLVING MATH ASSESSMENT RUBRIC

Created by Natasha Hutchins at www.prodivame.com

Check each sentence that is true for the Math task.	Beginning ★	Developing ★★	Achieving ★★★	Excelling ★★★★
Our Math	Our work shows that we need more help to understand this math concept	Our work shows some understanding of this math concept	Our work shows that we have a good understanding of this math concept	Our work shows that we have a thorough understanding of this math concept
Solution	• We still need to solve the problem or our answer is incorrect.	• We solved part of the problem correctly or made some small errors.	• We solved the problem correctly and labeled our answer.	• We solved the problem correctly using an efficient strategy and labeled our answer.
Explanation	• We should have included an explanation or description.	• Our explanation or description is unclear or incomplete.	• Our explanation or description is strong. We used some mathematical vocabulary.	• Our explanation or description is very strong. We used precise mathematical vocabulary.
Record	• We should have used a drawing or diagram, a graph or an equation to support our thinking.	• We attempted to use a drawing or diagram, a graph or an equation to support our thinking.	• We used a clear drawing or diagram, a graph, or an equation to support our thinking.	• We used a very clear drawing or diagram, a graph, or an equation to support our thinking.
My Skills Thinking	Comprehension • I can understand what we are learning about when it is shown or explained to me. Application • I can follow someone else's demonstration. Metacognition • I can listen to others say what they are thinking.	Comprehension • I have understood what we are learning about. Application • I need some help to apply what I have learned. Metacognition • I can say what I am thinking.	Comprehension • I have understood what we are learning about and I can communicate it. Application • I can apply what I have learned. Metacognition • I can say what I think and explain how I think.	Comprehension • I have understood what we are learning about. I can communicate my understanding of it. Application • I can apply what I have learned in new situations and help others too. Metacognition • I can explain our thinking and how we think.
Social	Group decision-making • I listen to others.	Group decision-making • I listen to others and discuss ideas.	Group decision-making • I listen to others, discuss ideas and ask questions.	Group decision-making • I listen to others, discuss ideas and ask questions. I can work towards and reach a consensus with my group.
Self-Management	Organisation • I begin solving the problem straight away. Time Management • I can follow time plans and observe others finding a solution. Codes of Behaviour • I can work in a group with some help from others.	Organisation • I plan out the steps before I begin. Time Management • I need some help to focus or find an accurate solution. Codes of Behaviour • I can suggest how we should work in a group.	Organisation • I plan and carry out the steps. Time Management • I worked to achieve an accurate solution. Codes of Behaviour • I can work effectively in a group.	Organisation • I plan and carry out the steps effectively. Time Management • I am focussed and succeeded with a accurate solution in minimum time. Codes of Behaviour • I help myself and others to work effectively in a group.
My Attitudes Commitment	I am committed to learning what I need to in Math. I persevere to solve the problem. I show self-discipline to stay focussed and work with others. I show responsibility to others and my Math.			
Confidence	I feel confident in my Math ability and my skills. I take risks to try new strategies. I apply the Math I have learned as soon as I can. I make good choices and decisions in Math and in a group.			
Cooperation	I work cooperatively. I use my manners. I share materials. I take turns. I work out the Math steps with my partners. I work out a Math solution with my partners. I lead kindly. I follow well.			
Creativity	I am creative in thinking about a Math solution. I am creative in working out how to solve the Math problem. I am creative in working out how to solve any problems within our group.			