A Strategy is an organized approach used in solving a problem. Such an organized approach identifies steps or stages for different parts of the process. For example, there is usually a stage called "Read the problem". Another stage might be called "Check the answer I obtained." The author George Polya describes a four-step strategy that includes the steps "Define, Plan, Do it, and Look Back". A strategy is important because:
- we all usually use one,
- a strategy helps us to be organized and systematic,
- having a strategy helps to calm us down if we become anxious when we are given a very difficult problem to solve,
- having a strategy helps us to "monitor" our mental processes.

In this UNIT the goal is to help you to discover names for the stages you use, to help you identify the thinking and attitudinal skills needed during different stages, to help you see how many minutes you spend in the different stages and to help you to monitor your thinking. To help you get this skill, two of you will work together: one will play the role of a "TALKER and marker mover"; the other plays the role of the "LISTENER and recorder".

![Stage-time charts of two problem solvers](image)

Example evidence (top) and TAPPS showing problem solver (on the right) and listener-recorder (on the left)
McMaster MPS 4: Strategy © copyright, Donald R. Woods, 1998

**MPS 4: Strategy:** is the organized and systematic sequence of stages applied when problems are solved. Each stage is characterized by its own set of attitudes and thinking skills. Example: the six-step MPS problem solving strategy of Engage, Define, Explore, Plan, Do it, Look back.

**Skill development:**
1. More skill in being able to talk about thought processes
2. More practice to focus on accuracy (instead of on time)
3. More practice on being active and writing things down
4. Recognizing that others solve problems differently than they do
5. Acquire more skill at listening
6. Acquire more skill in self assessment
7. Acquire more skill in giving and receiving feedback
8. Through self awareness, to improve self confidence
9. Further emphasis that assessment is based on **evidence**
10. Continuing to develop an environment of trust where risking is OK.
11. Beginning to recognize patterns in the problem solving process
12. To realize that a “strategy” is not applied **linearly** and sequentially; that it is used flexibly.
13. To recognize the difference between **problems** and **exercises**.
14. Understand the relationship between subject knowledge, past solutions to problems and problem solving
15. To acknowledge the importance of **defining** problems and to recognize this as a three-step process.
16. To acknowledge the importance of **reading** the problem statement.
17. To realize that **problem solving** is not “doing some calculations.” Conversely, to correct the misconception that if you are not “doing some calculations” you are not solving problems.
18. To acquire skill is explicitly monitoring the process.

********************************

**Pretest:** It is very difficult to realize how much we change in our thinking and research skills from the workshop activities that you are going to do. To help you develop your confidence and be proud of the progress you make, before you do the workshop activities, please mark your skill now.

**Awareness:** how aware are you of what you do when you use a strategy? Rate with an “x”

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<thead>
<tr>
<th></th>
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<th>1</th>
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<th>4</th>
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<th>7</th>
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<td>I just do it</td>
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<td>Aware of I can describe</td>
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<td>Some The details of how I do it</td>
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**Skill:** how skilled are you in doing this activity? Rate with an “x”

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<th>10</th>
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<tbody>
<tr>
<td>Poor</td>
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<tr>
<td>Fair</td>
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<td>Good</td>
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<td>Very good</td>
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<tr>
<td>Excellent</td>
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**Comments:**

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**Learning objectives**
MPS 4 Strategy

1.1 given a term listed under "concepts introduced", you should be able to give a word definition, list pertinent characteristics and cite an example.

2.1 given the name "McMaster 6-step strategy," you should be able to describe each and list the cognitive and attitudinal dimensions associated with each step.

2.2 you will be able to describe the concept of "nested strategy" and given a problem, identify the number of times the 6-step strategy might be used to solve the problem.

2.3 given a problem in a TAPPS Whimbey-pair context, you should be able to verbalize the process and place a marker to identify the step (in the McMaster 6-step strategy) upon which you are working. The listener should agree with your assessment 80% of the time. You should need prompting no more than 3 times in a 7 minute period.

2.4 given a problem in a TAPPS Whimbey-pair context, as a listener you will encourage verbalization, an emphasis on accuracy, active thinking and problem solver to move the marker correctly on the strategy board. Your interventions will be judged by the problem solver to be helpful, and not judged to be disruptive.

2.5 given the TAPPS Whimbey-pair context, you should exhibit 4 verbal management statements during a 7 minute period of problem solving.

2.6 you will be able to list the misconceptions people hold about the use of strategies.

4.1 given a problem in a TAPPS Whimbey-pair context, as a listener you will be able to identify monitoring statements said by the problem solver. Your assessment will agree with the tutor’s assessment 80% of the time.

5.1 given your goal is to improve your application of a strategy, you will be able to identify subgoals, write these in observable terms, create consistent measurable criteria, gather evidence to substantiate claims and write a reflective journal to summarize your claims.

6.1 given evidence gathered from a strategy workshop, you will be able to assess the degree to which goals of the workshop have been achieved. Your assessment will agree 90% with the tutor’s assessment.

Concepts introduced

McMaster 6-step strategy, criteria for selecting a strategy, attitudinal and cognitive dimensions of each step in the strategy, Schoenfeld's monitoring/management, nested strategy, role of TAPPS problem solver, role of TAPPS listener, three stages of defining a problem, importance of creating the internal representation, importance of reading the problem statement.

********************************************************************
Playing the role of the TALKER-MOVER of the marker.

Your role is to talk aloud when you work on the problem and you are to move a marker on the "strategy board" so that you show which stage your thinking is in.

This is difficult to do. Be patient with yourself.

You may not completely understand the meanings of the stages yet. You may use different stages than the ones on the Strategy board. Please, do your best.

The listener will not move the marker for you. The listener will no tell you what stage you are in. The listener might ask you "are you still in the "Explore" stage?"

Remember to keep talking, to be active, to use pencil and paper, and to check and check again. Before you start, go over the meanings of the 6 different stages in the McMaster-6-Step strategy with the LISTENER. Agree on the meanings of the words.
1. Sit side by side; have paper and pencils available, have the Strategy board and the marker.
2. The talker moves the marker to the READ part of the Strategy Board and starts by reading the problem statement aloud.
3. Then move the marker to whatever stage you are going to work on next and start to solve the problem on you own. Keep talking aloud. You are solving the problem. Your partner is only listening to you. He or she is not solving the problem with you or for you.
4. Talking and thinking and moving the marker at the same time are not easy. You might forget to move the marker. That is OK. Do the best you can. You are playing the role and trying out something from Canada.
5. Go back and repeat any stage of the strategy you wish.

Playing the role of the LISTENER-RECORDER

You have an important and difficult role to play. You are to help the Talker see what he or she is doing as they talk about the travels of their mind as they solve problems and you are to record the amount of time the Talker spends in each of the stages on the Strategy Board. Do not correct them; do not argue with them about which stage the TALKER is working on. Do not move the marker for them. You may have to ask "Are you still in the >>>>>> stage? Before you start, go over the meanings of the 6 different stages in the McMaster-6-Step strategy with the TALKER. Agree on the meanings of the words. You might want to review the instructions for the LISTENER from MPS Unit 1 on AWARENESS.

Activity: In pairs, one be a talker, the other be a listener. The talker plays the role for __________ and “solves” problems during all the allotted time. Do not change roles.

Later you will switch roles.
The Strategy Board is given on Page 4-12
The listener record sheet is given on Page 4-13
++++++++++++++++++
Write evidence by reflection on Table 4-1 p. 4-5; Get evidence about the listening on Table 4-2, p. 4-6.
Monitor your long term progress with Table 4-4 on p 4-8
Table 4-1: A Place for you to Record your ideas about the Strategy Activity: Reflections

Being the TALKER-MOVER of the marker:

______________________________________________________________________________
______________________________________________________________________________
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Being the LISTENER/RECORDER

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About the process

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Table 4-2: **Evidence for listening**: Feedback to listener: listener you will encourage verbalization, an emphasis on accuracy, active thinking and problem solver to move the marker correctly on the strategy board. Your interventions will be judged by the problem solver to be *helpful*, and not judged to be *disruptive*.

Activity 1: talker ________________________ Case ________________ listener ___________________________

<table>
<thead>
<tr>
<th>Feedback to Listener</th>
<th>Talker Response</th>
<th>Listener Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>encourage verbalization:</td>
<td>not needed</td>
<td>interruptive</td>
</tr>
<tr>
<td>encourage emphasis on accuracy:</td>
<td>not needed</td>
<td>interruptive</td>
</tr>
<tr>
<td>encourage active thinking</td>
<td>not needed</td>
<td>interruptive</td>
</tr>
<tr>
<td>interventions:</td>
<td>not needed</td>
<td>interruptive</td>
</tr>
</tbody>
</table>

Comments:

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____________________________________________________________________________________________
____________________________________________________________________________________________
_________________________________________________________________________________________

signed ________________________________ talker

+++________________________________________+

Activity 2: talker ________________________ Case ________________ listener ___________________________

<table>
<thead>
<tr>
<th>Feedback to Listener</th>
<th>Talker Response</th>
<th>Listener Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>encourage verbalization:</td>
<td>not needed</td>
<td>interruptive</td>
</tr>
<tr>
<td>encourage emphasis on accuracy:</td>
<td>not needed</td>
<td>interruptive</td>
</tr>
<tr>
<td>encourage active thinking</td>
<td>not needed</td>
<td>interruptive</td>
</tr>
<tr>
<td>interventions:</td>
<td>not needed</td>
<td>interruptive</td>
</tr>
</tbody>
</table>

Comments:

____________________________________________________________________________________________
____________________________________________________________________________________________
____________________________________________________________________________________________
_________________________________________________________________________________________

signed ________________________________ talker

THIS PAGE IS COMPLETED BY THE TALKER BUT THEN BELONGS TO THE LISTENER
Schoenfeld and Voss have shown that we should "monitor" how well the thinking activities are helping us toward the goal of solving the problem successfully. The monitoring process includes:

- Assessing the benefit to be gained from a thinking activity or a calculation before we do it. For example, "If I calculate ..... what will that tell me?" "If I ask this question ......, what will that tell me?"

- Assessing whether a task is completed. This is a natural question that you ask yourself when you are ready to move the marker on the Strategy board. For example, "Am I finished with this?" "Now where do I go?"

- Assessing what you have learned if a hypothesis is shown to be wrong or if you calculate a "strange answer." For example, "OK, What did I learn from that?"

- Checking for completeness....
  - do you list the options? then put them in order of importance? and then check them off when you do them?
  - do you give up on a calculation without checking on what you learned from the work?

- Monitoring.... where you are and where you are going... at least once per minute.

Schoenfeld’s evidence is in Table 4-3; Other target evidence is shown in Table 4-4

Activity:
In the second time that you play the role of the TALKER-MOVER you will now try to say aloud the assessing and checking for completeness and monitoring described above.

In the second time you play the role of the LISTENER-RECORDER you will also put a little black arrow on the chart whenever the talker assesses, checks for completeness and monitors.


Table 4-3 : Schoenfeld’s research :

<table>
<thead>
<tr>
<th>Unsuccessful</th>
<th>Successful</th>
</tr>
</thead>
<tbody>
<tr>
<td>Don’t assess potential</td>
<td>Assess the potential: what will I learn if I do this calculation? Will this help me? How does this move toward a solution?</td>
</tr>
<tr>
<td>If fail, abandon</td>
<td>If fail ask “What did I learn?”</td>
</tr>
<tr>
<td>Make impetuous jumps with no apparent reason</td>
<td>Actions characterized by continual assessment &amp; curtailment</td>
</tr>
<tr>
<td>Within the first few minutes, become fixed on one idea</td>
<td>Qualitatively explores situation to fully understand; Keeps options open</td>
</tr>
<tr>
<td>No monitoring</td>
<td>Explicitly monitors about 1 / minute; and uses transitions between strategy stages as key monitoring/decision points. “Am I finished with this stage?” “Where now?”</td>
</tr>
</tbody>
</table>
### Table 4-4 Evidence-based targets for problem solving

<table>
<thead>
<tr>
<th>Evidence-based targets</th>
<th>Progress toward internalizing these targets</th>
</tr>
</thead>
<tbody>
<tr>
<td>● Spend time reading the problem statement. (Up to three times longer than unsuccessful problem solvers) (11, 24)</td>
<td>20%  40%  60%  80%  100%</td>
</tr>
<tr>
<td>● Define the problem well; do not solve the wrong problem. Be willing to spend up to half the available time defining the problem. Most mistakes made by unsuccessful problem solvers are made in the define stages (1, 3, 4, 11, 12, 19, 24)</td>
<td></td>
</tr>
<tr>
<td>● You solve your mental image of the problem; such a mental image is called the internal representation of the problem.</td>
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</tr>
<tr>
<td>● Differentiate between exercise solving and problem solving.</td>
<td></td>
</tr>
<tr>
<td>● Unsuccessful problem solvers tend to search for an equation that uses up all of the given variables. (1, 4, 11, 12, 14, 24) whereas successful problem solvers focus on an organized strategy that focuses on defining the real problem.</td>
<td></td>
</tr>
<tr>
<td>● Unsuccessful problem solvers tend to memorize and try to recall equations and solutions that match the situation instead of defining the real problem and identifying key fundamentals. (11, 6)</td>
<td></td>
</tr>
<tr>
<td>● Defining the problem is a three-stage activity (19, 24).</td>
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<tr>
<td>● Unsuccessful problem solvers tend to take a trial and error approach; successful problem solvers use a systematic strategy (6). Use a strategy to help you to be systematic and organized.</td>
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</tr>
<tr>
<td>● A strategy consists of a series of about 6 stages. Each stage uses different thinking and feelings. This strategy is not used serially (following rigidly one step after another). Rather it is used flexibly; applied many times while solving a single problem with frequent recycling from one stage to another. (24)</td>
<td></td>
</tr>
<tr>
<td>● Problem solving skill interacts with subject knowledge (needed to solve the problem) and with the sample solutions (from past solved problems).</td>
<td></td>
</tr>
<tr>
<td>● Successful problem solvers monitor their thought processes about once per minute while solving problems. (20, 19)</td>
<td></td>
</tr>
</tbody>
</table>

References 1 to 24 are from the Novice versus expert research summarized in PS News 55
STRATEGY Board: (from Woods, "Problem-based Learning: how to gain the most from PBL," 1994)
**Table 4-5 Record of the Talker’s strategy**

<table>
<thead>
<tr>
<th>Talker</th>
<th>Case</th>
<th>Listener</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Stage</th>
<th>“Define” Assess</th>
<th>Plan</th>
<th>Implement</th>
<th>Evaluate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Read: “I want to and I can!”</td>
<td>Define-the-stated problem: Sort the given problem statement</td>
<td>Plan</td>
<td>Do it</td>
<td>Look back: elaborate, check</td>
</tr>
<tr>
<td>Explore the problem to discover what the problem really is</td>
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</tbody>
</table>

(With ▼ for monitoring statements)

**Additional feedback to the talker/Problem Solver:**
- Number of silent periods (10 s): 0 1 2 3 4 5 ▼
- Number of checks, double checks: ▼ 5 4 3 2 1 0
- Amount of writing/charting: ▼ 5 4 3 2 1 0
MPS4-11

**DISCOVERY**

<table>
<thead>
<tr>
<th>Activity</th>
<th>Discovered</th>
<th>So what? application</th>
</tr>
</thead>
<tbody>
<tr>
<td>TAPPS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Know names of stages in MPS 6 step strategy</td>
<td></td>
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<tr>
<td>Create your internal, mental representation of the problem</td>
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<tr>
<td>Move marker on strategy board</td>
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<tr>
<td>No silent periods, focus on accuracy active writing, tables, underline</td>
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</tr>
<tr>
<td>Be the listener, recorder</td>
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<td></td>
</tr>
<tr>
<td>Monitor</td>
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</tbody>
</table>