For successful synthesis to emerge, three associated levels of thinking must all occur at the same time in a dynamic, three component process which is a great deal like writing poetry or songs. All three levels operate concurrently and recursively (like the cat chasing its tail). The three levels of thinking are: Envisioning, Inventing, and Rearranging or (SCAMPERing).

a. Envisioning

The top level involves conjuring and envisioning types of thought. The students conceive, conjecture, fancy, imagine, project and visualize. The students who have studied the five New England cities, for example, are now ready to write narratives describing what a typical day might be like in each city. Now that they have a pack of details and facts bundled into a da abase, it is time to translate them into scenarios which might help answer the question, "So what? Just how dangerous would it be to walk down those mean streets? How might it feel? Could I be proud sitting in the football stadium?"

Envisioning is the top level because it lifts the outcomes of the research beyond past practice, antiquated mind-sets, set recipes and old thinking. The researcher leaps out of the box of everyday, ho-hum thinking.

The Internet lends itself especially well to the encouragement of such flights of fancy. The Net provides the excursions, journeys, safaris, sallies, treks and spins trainers often employ to stimulate creative problem-solving in groups. Envisioning is the source of originality. Identifying possibilities and exploring the unthinkable is basic to this level.

b. Inventing

The middle level requires translation of possibilities into actualities. The imaginative play of the top level must be grounded in reality. What might actually work? What is a sensible version of that possibility?

This is the level at which innovation is born. The student concocts new solutions to problems or coins new ideas and general principles. The research team may hatch a whole new action plan, fabricating and formulating initiatives to clean up local streams. Perhaps the thinking may advance to the development and testing of prototypes before engineering a final product.

For the team comparing and contrasting the five New England cities, they must invent pictures of their cities before they can make any kind of choice. The encyclopedia provides information about these cities, but very little of that information would shape the daily lives of our students. Their job, now that they have visited the Internet, is to construct a picture of how life with their families might play out in each setting.

c. SCAMPERING and Rearranging

The foundation for the top two levels is the rearranging mentioned earlier in this series in sections on sorting and analyzing data. A team formulating a plan to protect the salmon may take and mix up the elements from successful strategies employed to protect other endangered species. This is no time for imitating recipes of the past, in part because none of them have been fully successful. The students search for a unique plan fashioned out of old parts and new parts.

One model for such synthesis is SCAMPER,with each letter standing for a strategy.

S = substitute
C = combine
A = adapt

M = modify, magnify, minify
P = put to other uses
E = eliminate
R = reverse

For this component of synthesis to produce powerful results, the other two components - inventing and envisioning - must be operating concurrently, as they supply the pressure which inspires creation. The student arranges, blends, combines, integrates, tests, and adjusts the thought fragments until new pictures emerge and the pressure eases.

13. Divergent and Creative Thinking (K-12)

There are many questions that can help students to "think laterally" (deBono) or "get out of the box." This ability to extend beyond the obvious and the time-worn is an essential ingredient in effective problem-solving because it helps to generate the unusual and imaginative solutions we associate with the skill of synthesis, the rearranging, modifying and combining of elements in novel ways to achieve desired and often startling results.

SCAMPER is one set of questioning strategies that works well. Students can be taught to ask how to change an existing product, item or idea by asking how to **S**ubstitute, **C**ombine, **A**dd, (**M**odify, Magnify, Minify), **P**ut to other uses, **E**liminate, and **R**everse (Eberle, 1972). SCAMPER tools are used on answers that we already have to questions, when we need a detour in our thinking to see something in a new way. It requires the suspension of judgment and a playful attitude. Many of the ideas will not lead anywhere, but they may add up to be more than the sum of their parts.

To use SCAMPER tools, take the answer to a question such as, "Thoreau wrote Walden" and ask the questions:

S "Who else could have written it?'

C "If Thoreau had had a co-author, who could it have been?"

A "What would Thoreau have written in the 21st century?"

M "What could we modify in the work to intensify the theme?"

P "How does this work apply to the lives of suburbanites?'

E "What would be the effect of eliminating this work?"

R "What would be the antithesis of Thoreau's view?"

One of the benefits of using the SCAMPER tools with students asking the questions is that they both ask and answer the questions. The questions, though often very divergent, require a thorough going knowledge of the required content. Evaluation of student thinking and competency in the subject matter are accomplished through an analysis of the coherence of the question asked, answer given, and next questions posed.

2. The Skill of EVALUATION

Seeing what's missing

"What do I know now that I didn't know then? What is it that I don't know?" When we set out to explore essential questions like those outlined in the opening article of this series, we usually do not know enough to ask the right questions. We don't know what we don't know, so we have trouble planning our research to fill in the gaps.

Once we have visited and begun to gather fragments, our understanding of the topic shifts and we realize we need to go back and reconsider the original research plan. As we arrange our fragments and begin to fashion meaning from what we have at hand, the shape of what is missing stands out as "negative space" just as the half-finished jigsaw puzzle hints at the shape of missing pieces.

At times, the enormity of the data cascading into our computers creates the false impression that we have fully explored some topic. Experience shows that even when we have mountains of data, we may have missed really important information. As swift as the search engines may be at locating documents, they are also quick to bypass and overlook.

The team exploring cities may have found the homicide rate for each city, for example, which would give some idea of the risk associated with living in each city. But the team has no intention of living in the whole city, so the crime rate for all of Boston doesn't tell them if they would be safe in the neighborhood they prefer. They probably need to know how many people get killed in Back Bay and the sections of Boston they might visit on a daily basis.

3. The Skill of EVALUATION

Planning further research

"What more do we need to know?" Synthesis following the first round of visits to the Internet is likely to leave the research group feeling unsatisfied. While the students may be approaching insight, it will remain elusive and poorly focused without repeating the research cycle listed at the beginning of this article:

- questioning
- planning
- gathering
- sorting & sifting
- synthesizing
- evaluating

Early visits provide the basis for a more informed effort at the questioning and planning stages.

4. The Skill of EVALUATION - Scanning from the crow's nest

Maintaining perspective is paramount. While conducting research we can be trapped in the day-to-day survival activities going on at the deck level. We are too close to the action to see the patterns in it. "Climbing the mast" means stepping outside and above the activities to see them with some distance and perspective. The crow's nest allows one to look beyond the ship to ask questions about the challenges and goals which lie ahead. It means keeping the big picture and the essential questions in mind.

Each research team needs to step out of the activities periodically and ask a few questions. "How are we doing? Is our plan working? Do we need to shift strategies? Change our focus? Ask different questions? Consider different sources?"