THOUGHT PROCESS-BASED LEARNING

Book #3

Level 1-2: Connecting concepts: foundation of creative thinking!

Creating concepts like a satellite back in the time when there were no satellites could be almost impossible. Nonetheless, Isaac Newton laid out the artificial satellite concept by connecting force and gravity concepts. With the connecting concept training methods provided in this book, you will be led to build foundation skills of creative thinking.

MIN

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About author

Tongpil Min has a Ph.D. in Biochemistry and has worked in the science field for more than 10 years. When his son was diagnosed with high functional autism about 10 years ago, he decided to develop educational method to teach his son. But later, he found that the educational methods he had been developing were not just for children with the autism spectrum disorder. They can be applied to anyone since the methods are directly tackling the thought process of the brain. He decided to publish the series of the thought process-based education books to be used as textbooks for the learners who would like to develop their brain power.

Currently, he provides workshops, consultations and training sessions on 'thought process-based learning and teaching method' for learners, educators and educational organizations.

GLOSSARY

Building concept – a process of conceptualizing knowledge or words. The process is composed of observation, descriptions and questions.

Concept – a process of digesting knowledge with observation, descriptions and questions. Unlike simple understanding of knowledge which blocks brain from thinking, a concept stimulates brain to expand thinking process further.

Conceptualization – a process of building concepts of knowledge or words. For example, knowing the word "apple" by understanding stops thinking once apple is understood. However, the process of conceptualization forces the brain to think further with observation, descriptions and questions.

Concept-connection – a method to link two or more different concepts. For example, connecting the concept of "apple" with the concept of "gravity" as in 'an apple falling from an apple tree' is the process of concept-connection. Only then, can the simulation of relative relationship between gravity and a falling object be started.

Knowledge – information stored by understanding consequences for later use. For example, if there is a fruit with toxin, one doesn't necessarily need to know how the toxin causes sickness. Simply remembering the knowledge of 'the fruit has toxin' by understanding the result 'make sick' is good enough for survival. Thus, knowledge refers to the information being stored in the brain by understanding.

Thinking process – a series of brain work that includes data collection (observation and description) and analysis (comparison, experiment, another observation etc.), prediction and decision making.

Contents

Introduction

Although artificial satellites orbiting earth are nothing special nowadays, it was unimaginable in the 1600′s when Isaac Newton lived. Newton′s revolutionary thinking based on the relative relationship among the concepts of force, gravity and attraction laid out the artificial satellite concept, which made today′s artificial satellites possible. This type of thinking is creative thinking.

Creative thinking is completely different from discoveries or new development of technologies that are made as needed. Discovering new phenomenon or objects is observation rather than thinking. It could promote thinking process. For example, if someone finds a stone that no one ever seen before, the person could start to explore the characteristics of the stone. In this case, the discovery or observation can lead to thinking. However, if the person ended naming the stone and not exploring further, the process of thinking wouldn′t be involved. Thus, discovery of something that exists has to be clearly distinguished from other kinds of thinking, especially from creative thinking which requires brain function of simulation with the concepts connected.

Development of new theories or technologies based on existing ones, on the other hand, can be confused with creative thinking since both are developed from one's ideas. For example, some might consider developing a jet engine from a propeller engine or making an iron hammer from a stone hammer as a creative thinking. Strictly speaking, these types

of thinking such as advancing technology through imitation or modification, are not creative thinking from thought process-based education viewpoints because the improvement is based on something similar that already exists. Improvement by modification of something that exists can be considered as need-based 'goal-oriented thinking' because needs are driving force for the thinking process. It can also be considered as 'thinking outside the box' because in order to develop new technologies from existing ones requires new ideas by observing the existing ones outside the box.

Creating the concept of the artificial satellite when there is no such thing to observe at all requires brain power to create new out of nothing, like Isaac Newton did. Once the artificial satellite concept is laid out or visualized, on the other hand, it would be relatively easy to develop an actual artificial satellite using established concepts. Extracting new information such as the orbiting speed, size and distance from the earth, or similar applications, and even predicting its future development based on goal-oriented thinking could be followed by. The most difficult part is to simulate and create an earth-orbiting object using brain

power of simulation while any observable objects fall to the ground without exception. This is true creative thinking – **creating something entirely new from nothing**.

For these reasons, the creative thinking in this book refers only to the brain power to produce completely new concepts that never existed before by making connections among the concepts that are far apart from each other. It is like creating a stone hammer from a stick, a vine and a stone as shown below.

Creation of new concepts requires the simulation function of the brain. When Isaac Newton dreamed about an orbiting object around earth, he must have simulated and predicted what would happen if an object was thrown with enormous power that is enough for the object to orbit the earth to come back to the origin. In order to create new concepts, simulation of relative relationship among the concepts of force, gravity, mass of an object and more is essential.

The simulation of relative relationship among two or more concepts shouldn't be confused with random imagination or fantasy like a Peter Pan movie. The simulation to create a new concept should be based on solid theories that are well established from observation and logical causality that connects causes and results.

Building the power of creative thinking skills requires training your brain in completely different ways from currently known educational methods that focus on obtaining knowledge. The key methods to train the brain to think creatively are concept-connection

and simulation using those connected concepts. With a single concept alone, the simulation process will be limited to the given information of that specific concept. For the brain to create something new, linking two or more distinct concepts are required prior to simulate their relative relationship. Simulation is a higher-level brain function that requires concept-connections. Therefore, this level 1-2 training will be focusing on connecting concepts as the foundation of creative thinking.

There are three different methods for connecting concepts:

1. List method,

2. Flowchart method and

3. Combination method (combination of the list and the flowchart methods).

1. List method

Introduction

Learning knowledge is not “thinking”. Thinking is a series of processes that the brain collects and analyzes data, predicts and makes decision. Acquiring knowledge is possible without a thinking process because it only requires brain′s understanding and memory function. You can even use and teach the same knowledge in the same way that you learned. The ability of understanding consequences and remembering the knowledge is the basic function of the brains of all animals with brains. This is transformed imitation and does not involve the process of analyzing data observed and drawing conclusions. For that reason, you cannot improve your thinking skills by gaining knowledge. Indeed, in order to develop the brain power of thinking, you must follow each step of the thinking process. The first step is to conceptualize knowledge (words) by yourself. Without conceptualization, even if you make connections, your brain wouldn′t be able to expand the connections.

All the methods provided in this book are based on the condition that you already have conceptualized or will conceptualize all the knowledge (words) prior to proceeding with each step by using the book #2 ‘Level 1-1 building concepts′. Only then, can you connect concepts, not knowledge.

Remember! Conceptualized knowledge and simple knowledge work differently in terms of the thinking process. You can learn new knowledge such as ‘rain forms when water molecules in clouds are condensed by cold temperatures′ either through personal experiences or learning in a science class. When you learn this knowledge, it is not you who made the connection of the concepts of rain, cloud and temperature. You are simply accepting the knowledge which was already built by someone. This is passive learning because you are not using your brain to make connections. You are simply waiting for

someone to teach you the knowledge. Therefore, brain power of thinking process cannot be expected to develop.

On the other hand, if you conceptualize knowledge, you can create connections by yourself. And you can even expand the new concepts further. In case of the ‘rain’, as you conceptualize the knowledge, you will find that it includes condensation, gravity, temperature differences and many more concepts already. Since everything is ready, the next step is as simple as to make connection with clouds. Then, you can create the new concept similar to the one above and expand further with questions like ‘why are water molecules condensed in low temperature?’ Even if you come to the exact same conclusion as known already - ‘rain forms when water molecules in clouds are condensed by cold temperatures’, your brain development is advancing. When you connect concepts by yourself, you are building skills to explore the unknown while knowledge stays as knowledge.

'Do I need to conceptualize knowledge?'

Please follow these two steps to check if you need to conceptualize knowledge. You can use this method to check if you need to build concepts before proceeding with each step for all three methods in this book.

Step 1. Ask a question to define the word and answer to the question.

Example,

Question to define: what is rain?

Answer to the question (write the description in detail): 'Rain is water drops formed when cold air makes water molecules in clouds condense.'

Step 2. Make a question(s) using the description from Step 1.

Example,

Why are water molecules condensed in low temperatures?

If you are able to go through these two steps, you have conceptualized the knowledge and you can use this concept to make connections. If not, build concepts using concept building method before making connections.

Now, let's move on to the list method.

Step 1. Choose a topic.

Since this list method is the simplest among the three methods, the appropriate topics are something that you can observe and make connections without much effort such as water or seasons. As an example, water will be the topic for the list method.

Step 2. Make questions that will be used to observe the topic.

Examples

- What types of water bodies do I see or know?
- What types of water states do I see or know?
- What types of phenomena related to water do I see or know?
- And more questions

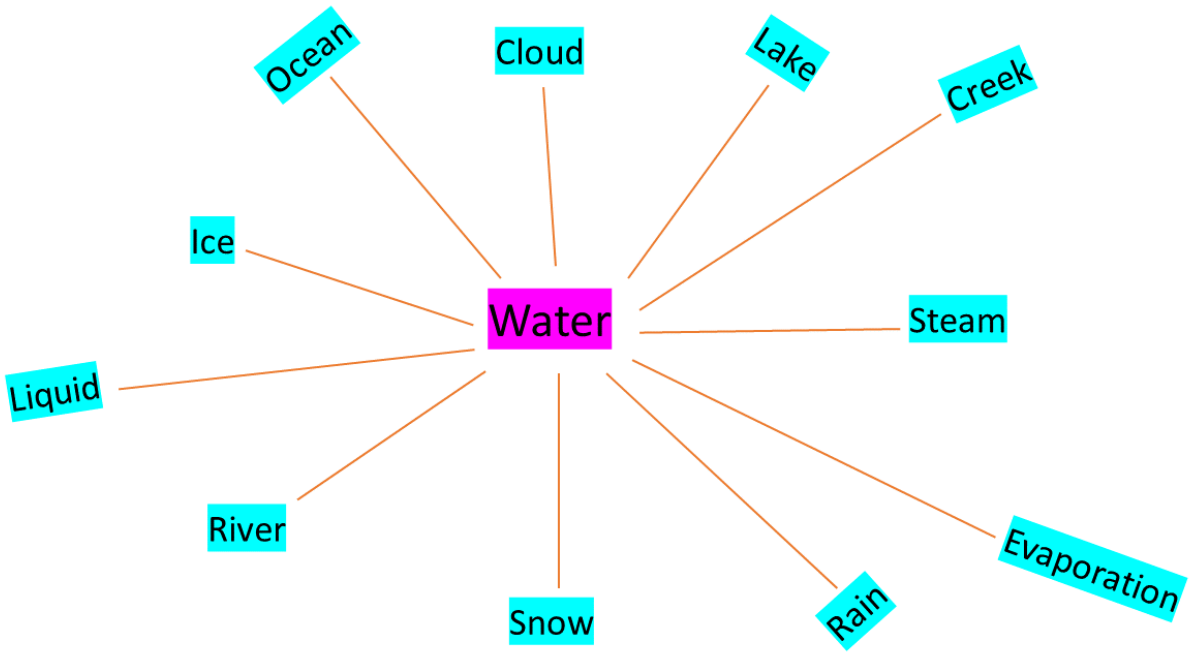
Step 3. List any concepts or knowledge that will answer the questions made in step 2.

Examples

- Ocean, lake, cloud, river, rain
- Snow, ice (solid), water (liquid), steam (gas)
- Evaporation, condensation
- And more concepts or knowledge

Step 4. Create a radial diagram around the topic using the listed concepts or knowledge from step 3.

Example



Step 5. Complete the concept building for each knowledge in the diagram using concept building method.

Note: Once again, concept and knowledge are two different things in terms of thought process. As you have been training yourself with the concept building method, you might have built some concepts already. If any of the words (knowledge) are unconceptualized, you will need to build its concept before proceeding to step 6.

Please refer to thought process-based education book #2, Level 1-1: Building concepts; foundation of thinking outside the box!

Step 6. Select any two of the concepts from the list, and then generate a question that connects them.

The question linking two concepts should include one of the two selected concepts in the question.

Example

River --------- Ocean; Where does a river flow to?

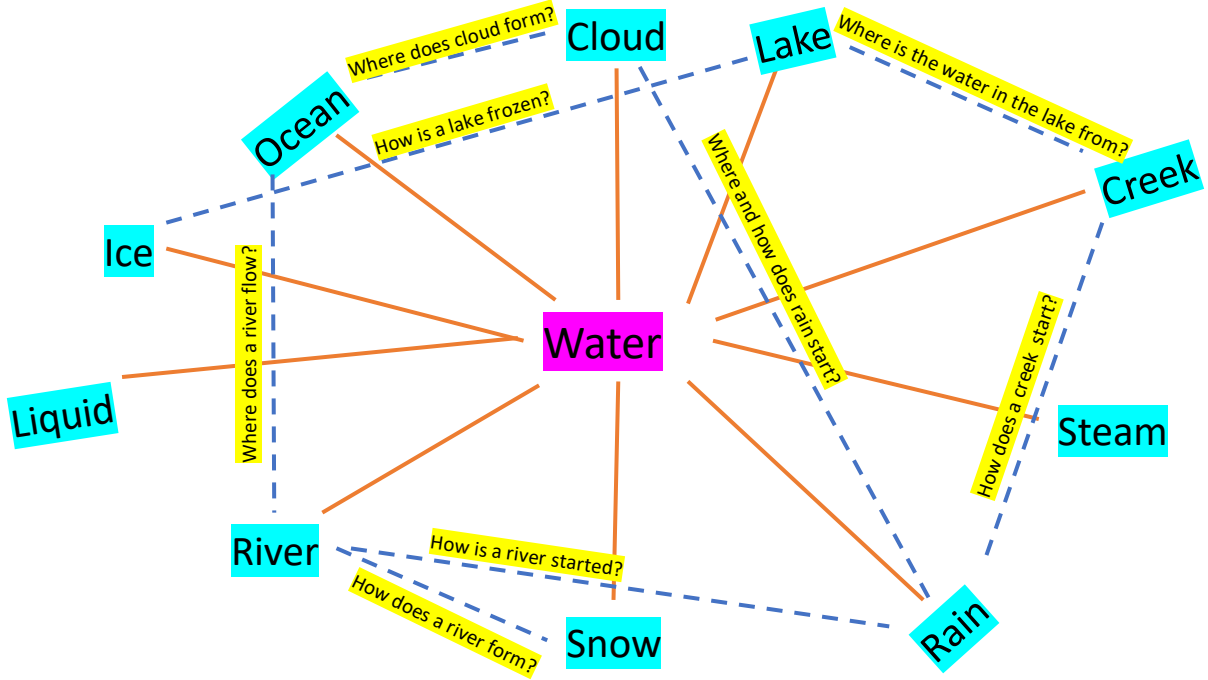
There are two concepts, river and ocean. The question included river.

Ocean --------- Cloud; Where does cloud form?

Ice --------- Lake, Lake --------- Creek, Creek --------- Rain, Rain --------- Cloud, River --------- Rain, Snow --------- River

Step 7. Add the questions from step 4 into the corresponding parts of the diagram.

Example



Step 8. Answer each question created in step 5 with detailed description of connected concepts.

At this stage, it is important to use your own brain to find answers without using references. In addition, the description should include both concepts connected by the questions. Describe with details how the two concepts are connected.

Example

- **River ----- Rain;**

  Q) Where does a river start? (Since this question is to connect river and rain, both river and rain concepts have to be used in the description.)

  A) **Rivers** start from mountains (or higher ground level) when small streams of water from **rain** merged in lower ground level as they flow downhill.

- **River ----- Lake or Ocean;**

  Q) Where does a river flow to?

  A) **A river** flows into a **lake or ocean.**

- **Rain ----- Clouds;**

  Q) How is rain formed?

  A) **Rain** is formed when water molecules are condensed in the **clouds** when temperature is low.

- **Clouds ----- Lake or Ocean;**

  Q) How are clouds made?

  A) **Clouds** form when water is heated and evaporated from the **lake, ocean** ….

- **Ocean -----??? (Expanding the connections to unknown);**

  Q) How does the water in the ocean move?

  A) ***Unanswered question*** (Let's assume that you don't have answer to this question)

Step 9. Link the questions and corresponding answers in their logical order.

Leave currently unanswered questions as they are and list the answers to the questions that connect the concepts sequentially.

Example

How is rain formed? - - - - - - - - → Where does a river start?

- Rain forms when water molecules are condensed at low temperature in the cloud.
- Rivers start from mountains when small streams of water from rain merged.

↑ ↓

Where and how are clouds formed? ← - - - Where does a river flow?

- Clouds form when the ocean heats up and water evaporates.
- A river ends in a lake or the sea.

Unanswered question → How does the water in the ocean move?

Step 10. Summarize the logically arranged answers by closely linking them together.

Summarize the details of how the concepts are connected without omitting the content of the answers.

Example

When water is evaporated from the lake or ocean by heat, it forms clouds and clouds move by the air until they meet lower temperature like high elevations in the mountains. Then water molecules in the cloud are condensed to form rain and lands on the ground. Once waters are on the ground, they flow down to the lower places by gravity to merge to form a river which in turn, runs down to meet lakes or oceans.

Step 11. Find answers to unanswered questions using references.

Example

- **Ocean -----??? (Expanding the connections to unknown);**

  Q) How does the water in the ocean move?

  A) Example description from references:

  Cold water sinks down to the bottom of the ocean while warm water moves to the surface of the ocean. Differences in the temperature of seawater create ocean currents that circulate around the world.

Note: Instead of paraphrasing the information, you should use it as references to build concepts on your own. For detailed methods, please refer to the book #2 'level 1-1 building concepts'.

Step 12. Final summary: Merge the summary from step 10 with the description from step 11.

The red colored part is the description from step 11.

When water is evaporated from the lake or ocean by the heat, it forms clouds and the clouds are moved by the wind. When the clouds meet mountains where temperature is lower, the water molecules condense to form rain and the rains fall to the ground by gravitational force. Once waters are on the ground, they merge to form a river and flows to an ocean where the temperature differences force water to move to form ocean currents.

2. Flowchart method

Introduction

The flowchart method is different from the list method described earlier in two main aspects: types of concepts covered and ways of connections between concepts.

The list method is the basic and easiest method to be used in concept-connection. This is because concepts covered in the list method are mainly observable phenomena. For observable concepts, it is relatively easy to find the causality between concepts, so they can be connected sequentially based on the causal relationships without much difficulties. As such, the list method can be compared to threading beads.

Unlike the list method, the flowchart method can be applied to complex concepts that cannot be directly descriptive with five senses or that involve multiple phenomena. Therefore, this method is one step more advanced training than the list method.

Due to the nature of the complexity of concepts, concept-connection in the flowchart method can be branched out in various directions rather than in a linear format, depending on the concepts that are being dealt with.

However, this book will show only the approach without branching.

Let's start!

Step 1. Choose a topic.

The example topic will be oxygen.

Unlike the topic water which can be considered macro, oxygen is a concept that cannot be easily observed and explained by the five senses. Since the topic is micro, indirect observation (research) is the only way to observe. Because the information comes from research mainly and research for microscale topics is carried out under limited conditions, all the concepts related to oxygen are not fully connected. The flowchart method is for the micro topics. There are known research results, but the big picture is not yet fully developed like a puzzle. As in doing a puzzle, you will need to connect the concepts one by one. Sometimes, you will need to branch out from the mainstream but in this training, only the method without branching will be provided.

Step 2. Conceptualize knowledge related to the topic.

Conceptualization has two different meanings in thought process-based education: one, the process of building concepts by using knowledge you already have and by reference to the research of others; and two, the process of building bigger concepts by connecting concepts that exist separately. The latter case can be compared to wiring light bulbs with electrical cable. Here, the light bulb refers to each concept and the process of connecting the light bulbs with wires is further conceptualization of concepts. Just like all light bulbs connected by wires are lit at once when the switch is turned on (imagine a Christmas tree with lights), you can come up with all the concepts associated with it when you recall one of the concepts. Here each concept is a light bulb as well as a switch responding to the observation.

In this step, it is important not to use a reference in the beginning of conceptualization because your brains hold more knowledge than you are aware of. Training to utilize the

knowledge you already have in your brain will enhance self-confidence and make yourself think independently because you can find answers to the questions by yourself.

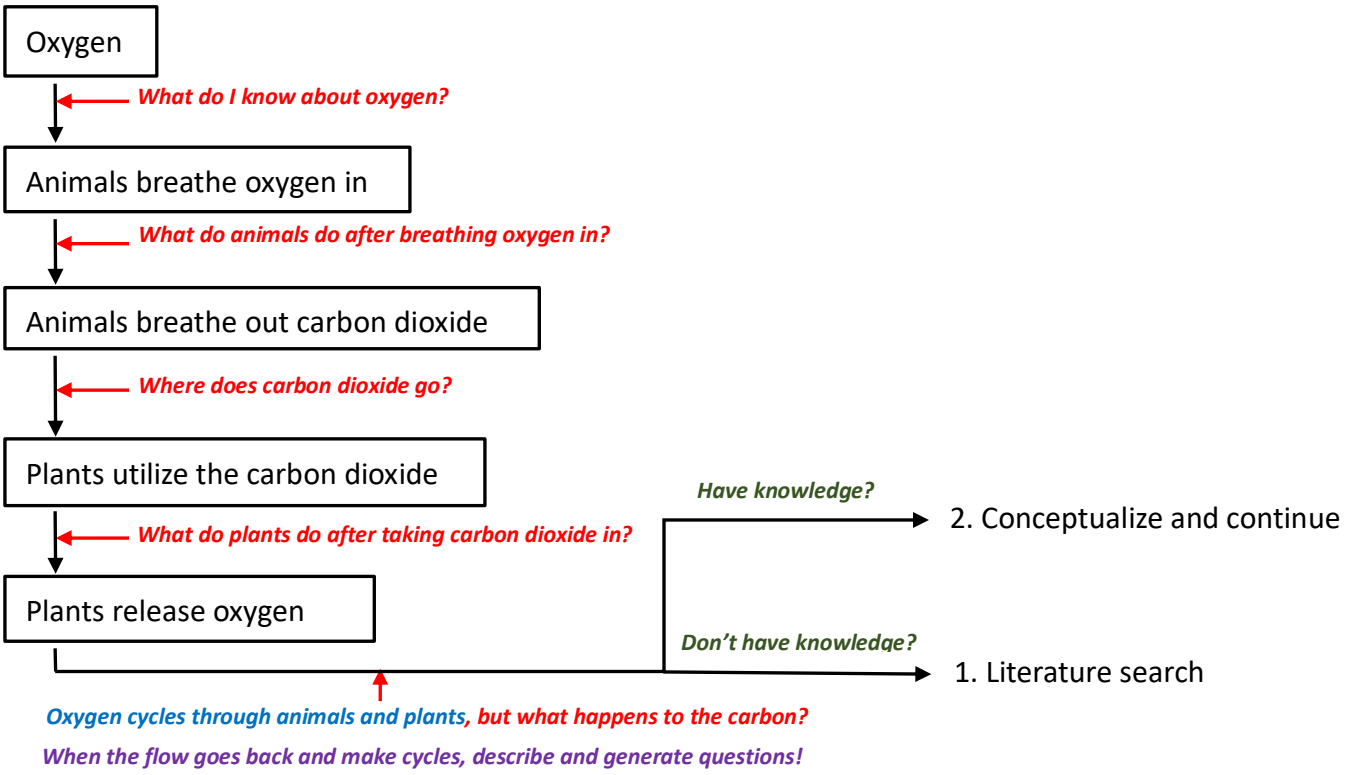
1) Generate a question that will bring out concepts related to the topic in your brain.

2) Describe the concept to answer the question from 1).

3) Make another question based on the concept from 2) to bring out another one.

4) Repeat the above process (questioning/answering based on your own concepts) to connect them sequentially until you no longer have any concept to connect.

Example



- If any word (knowledge) in the description has not been conceptualized earlier, you must build the concept of the knowledge using the concept building method before proceeding to next step (step 3). For example, in the description ‘Animals breathe oxygen in’, if you have not conceptualized ‘breathing’ previously, you should build the concept of ‘breathing’ before connecting to the next concept. Please see building concept method for more details on how to conceptualize knowledge by starting with a descriptive definition of a word.

- Logically connected concepts are easy to understand. In order to make concept-connection more logical, try to make connections with the causes and results.

- The questions in red could be the branching points. For example, with the second question ‘What do animals do after breathing oxygen in?’ could be branched to circulatory system instead of staying on the topic of breathing.

- Note that the above example is only a brief version of a flowchart to provide the overall procedure. You need to break down each connection into smaller steps by adding as many concepts as possible that you already have. For example, in the flowchart above, air exchange confined between animals and plants has been described. However, this connection can be broken down further by adding more information such as ‘carbon dioxide moves from animals to air and then, air to plants.’ Making a flowchart with small detailed steps will enhance the skill of describing in detail, which increases the likelihood of widening and deepening the expansion of concepts in level 2 training. Level 2 training starts with research questions to explore the unknown based on the description of connected concepts. As you connect more concepts, you will be able to ask questions to do research to

explore the unknown. Only then, can you develop and introduce something new to the world.

Please remember, you have to connect concepts. Not knowledge.

Step 3. Merge all connected concepts in the flowchart without omitting any information.

The key in this step is to describe all the information in the flowchart.

Step 4. Summarize merged description from step 3. (Examples are not provided)

The summary created in this step presents concepts that you established by connecting concepts on your own.

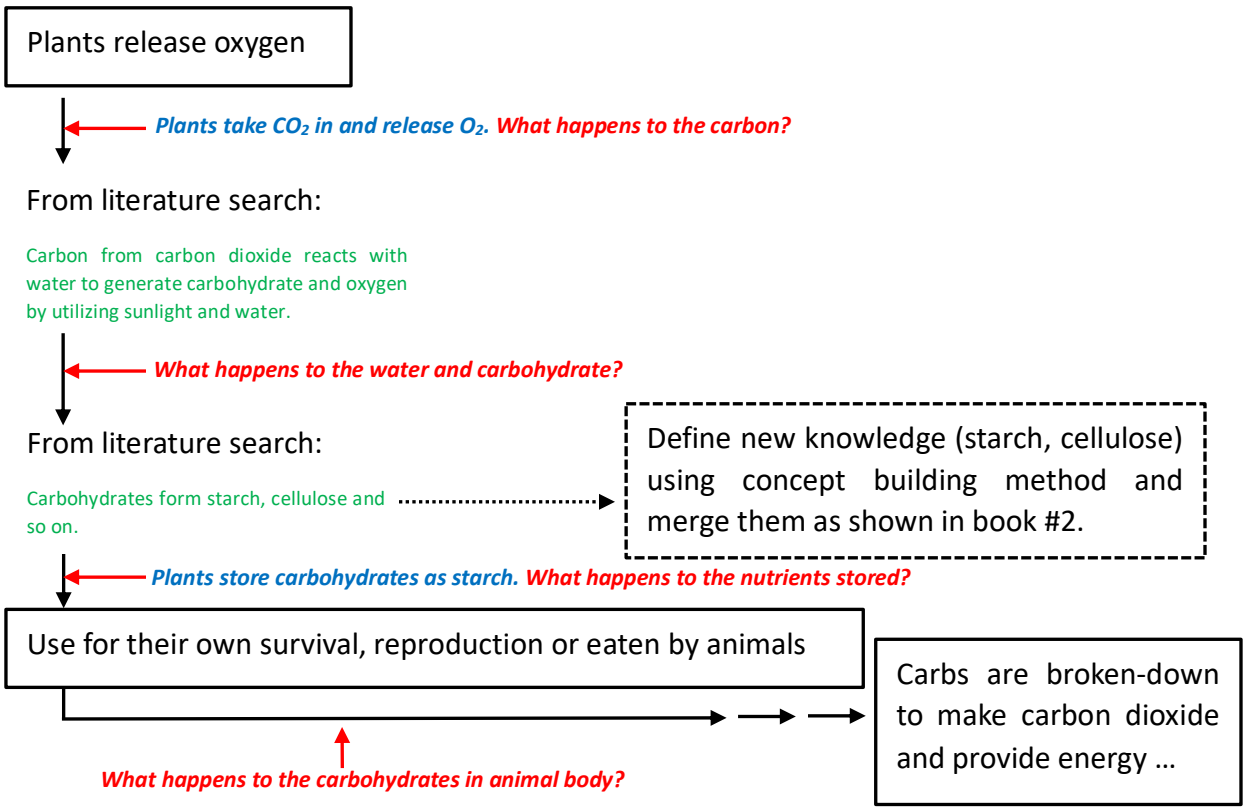
Step 5. Expand concepts by finding answers to unanswered questions in step 2 using references.

Keep in mind that all new knowledge cited from references must be conceptualized through the building concept method unless you already have the concept of the knowledge. Only then can they be used for concept-connection to conceptualize further.

To check if you have a concept of the knowledge, simply ask a question to define and define the knowledge and then make questions from the definition you made. This is the same method provided on page 7. For example, ask the question ‘what is an ocean?’ and

describe your answer like ‘Ocean is a water body containing salt where all the waters from the land merge.’ Then, make a question from the description like ‘where did the salt come from?’ or ‘why do waters from the land merge into the ocean?’ If you are not able to finish these steps, the knowledge has not been conceptualized. If you know a word as knowledge, you might be able to understand, use and teach the knowledge but you wouldn’t be able to use them for concept connections.

Example



Note: *All the new knowledge adopted from references has to go through the building concept method in order to build your own concepts, and only then can they be used in concept connection.*

Step 6. Describe each connection from the flowchart in as much detail as possible.

Describe all the information you wrote in the flowchart without omission.

Step 7. Merge the summaries from step 4 (done without references) and step 6 (done with references) to create a concise final summary. (Examples are not provided)

3. Combination of the list and the flowchart methods

Introduction

The two methods explained previously are used to connect concepts whose relationships can be either directly observable like rain and river or inferred relatively easily like oxygen and carbon dioxide. The combination method, on the other hand, can be used to connect concepts that do not appear to be linked to each other because their relative relationship is not obvious or difficult to infer.

To explain it clearer, the topics covered in the combination method can be compared to large companies (a complex topic) with many different departments (knowledge or concepts that make up the topic). While what each department does is different from one another and doesn′t seem to be related to each other, from the perspective of the company as a whole, the work of all departments is linked to each other somewhere so that company runs well.

Exploring these types of complex topics requires both the list method and the flowchart method, rather than one concept-connection method. Once you have decided a topic to explore, list the concepts that make up the topic in a radial form around the topic and connect them using list method first. At this point, if any knowledge is listed, the knowledge has to be conceptualized prior to connection. Then, conceptualize further using concepts listed using flowchart method to create more detailed links between concepts.

The example topic for combination method will be a human being.

Step 1. Choose a topic.

Choose a relatively familiar topic for which you have many concepts or knowledge already. This will increase the likelihood of creating more connections in STEP 2. Once you get

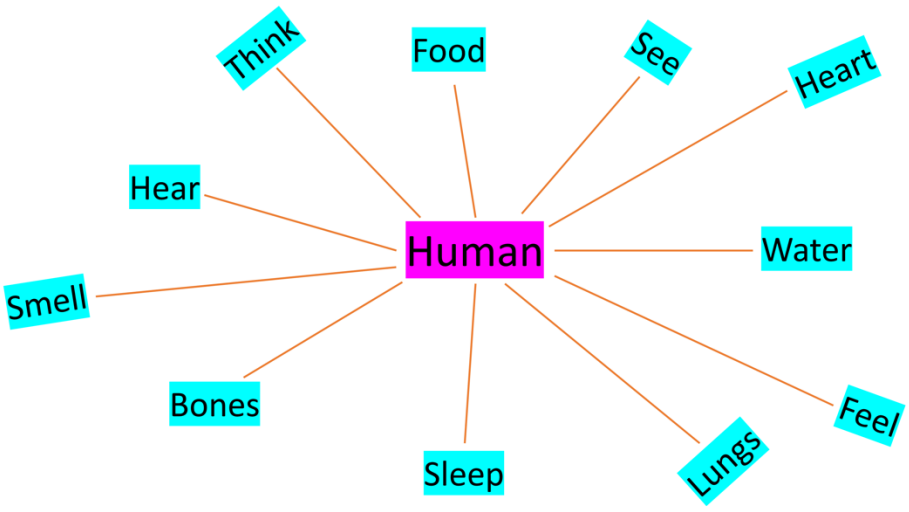
used to this method, move on to more difficult topics that consist of challenging concepts to connect.

Step 2. List knowledge or concepts on the topic and conceptualize the knowledge.

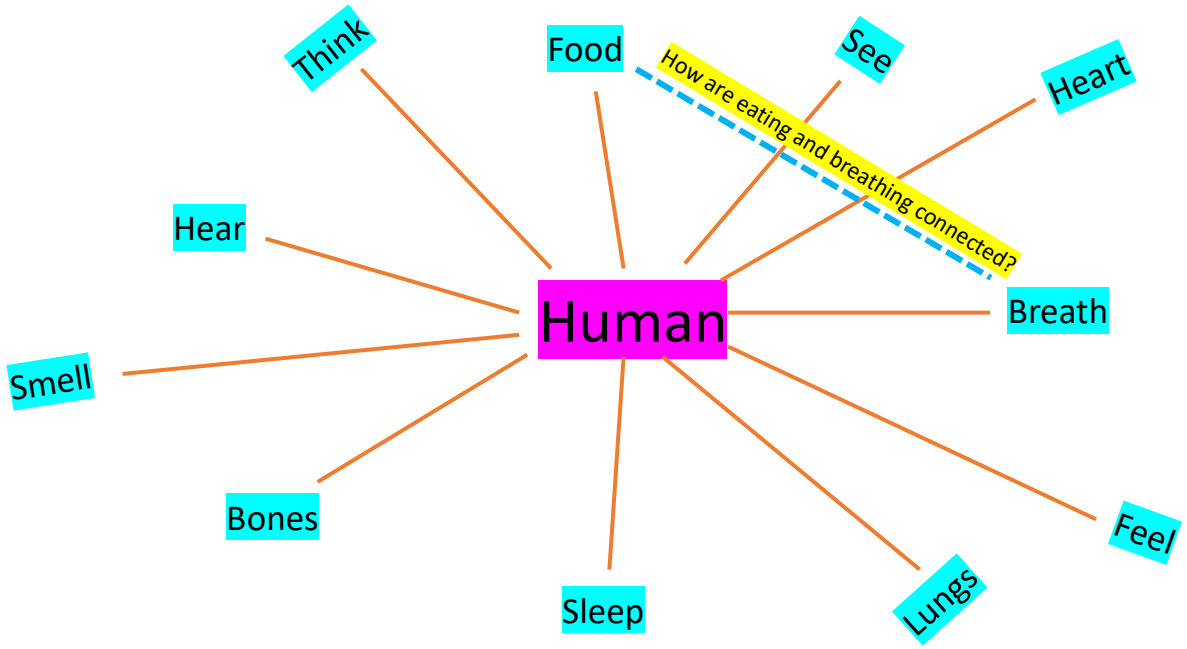
Start with observing the topic in great detail and then list as much knowledge or concepts as possible on the topic. For instance, if you are using 'human' as the topic, you can start making a list by observing yourself. Once the list is made, separate the knowledge and conceptualize it through concept building method.

Not all concepts in the list will be easy to work with. So, the more concepts you have, the more likely you are to create connections.

Step 3. Draw a diagram in the same way as the list method.



Step 4. Create a question(s) to make two concepts connected.



The most important training at this stage is not just to connect concepts, but to get used to 'asking questions' that connect them, that is, how to ask questions. This is an essential training especially if you are not confident in asking questions.

Coming up with questions to connect concepts like 'how is eating food connected with breathing air?' is relatively simple because all you need to do is combining the two concepts (eating and breathing) and the question (how are they connected?). However, no matter how easy this step may seem to be, it is important to go through 'making questions' on every single concept-connection without skipping any before proceeding to the next step.

By constantly asking questions, you will be able to objectify your own questions later, which is necessary for analyzing questions so that you can modify questions to find answers at higher level training. This is because not all questions lead to answers. There are certain types of questions that block thinking process and that can lead thinking process

toward to find answers. As mentioned earlier, level 1 trainings are foundation. From level 2 training, you will be trained to discern the questions that stop thinking process from the questions that promote brain thinking (research questions) and how to explore the unknown with the research questions. As mentioned previously, you can develop something new only when you can explore the unknown.

Connecting concepts, as described earlier, is similar to wiring light bulbs. When concepts (bulbs) are connected with questions (wires) thoroughly, all the concepts in the connection will light up together when any one of the connected concepts is switched on. This means that as you question more to connect concepts, more light bulbs will be lighted and make your brain brighter and brighter.

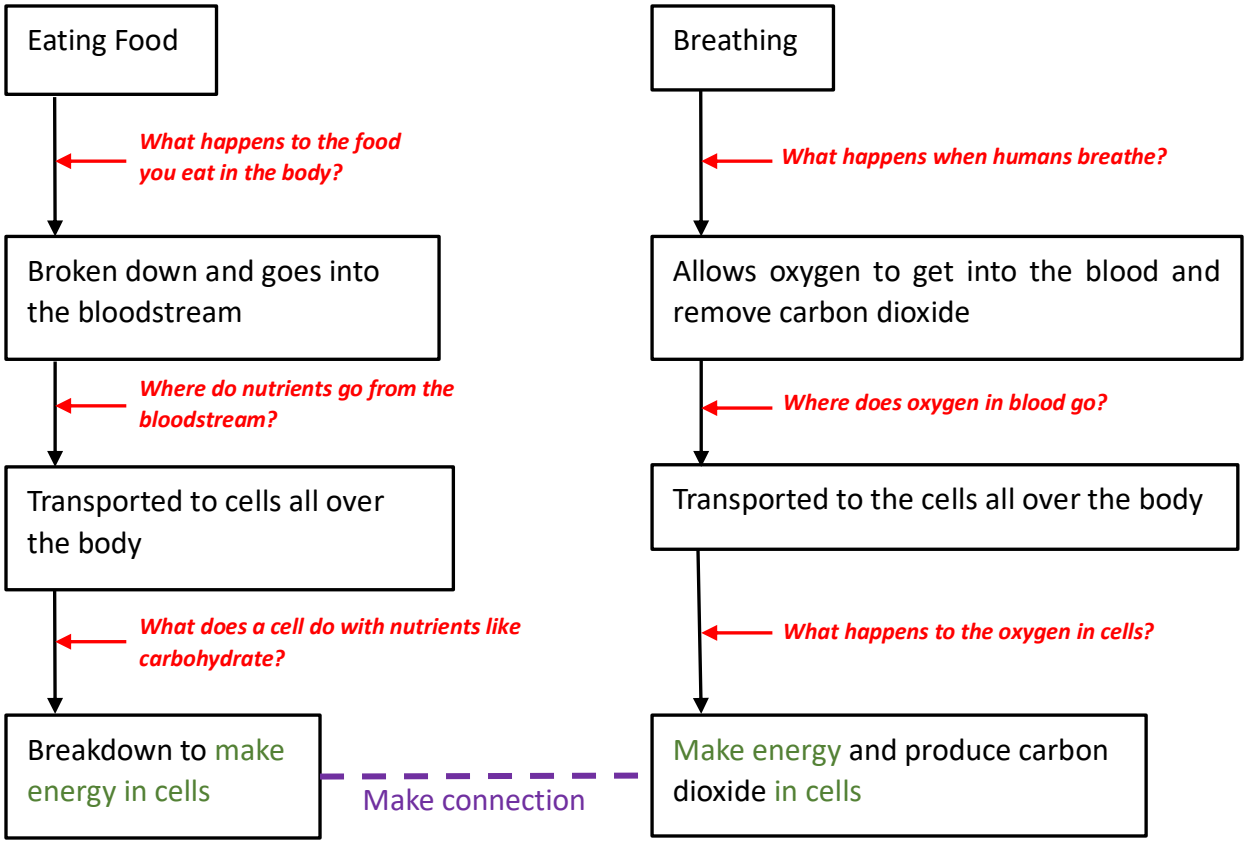
As an example, if you think of oxygen by any chance when discussing plant physiology, you can come up with all of oxygen-associated concepts built by concept connection method, such as carbohydrates, fatty acid and many more.

For now, you are training to connect concepts that exist. But the skills of connecting concepts will play an essential role when you try to explore the unknown. Unknown means no bulbs and no wire. It is you who has to wire and create bulbs to light the darkness.

Remember, the entire world is connected. It is matter of how to find the connections.

Once the process of interconnecting all the concepts has been completed, the connection will stimulate the brain to simulate the relative relationship among the concepts connected to create new concepts.

Step 5. Explore each concept using flowchart method.



After completing step 4, all concepts should be conceptualized further by the flowchart method. In order to connect two concepts that interest you, look for common factor(s) from both sides (in the example above, 'Make energy in cells' at the bottom boxes) to make connections. Once two concepts are connected with common factor(s), you can generate research questions. For example, 'How do carbohydrates and oxygen react to make carbon dioxide in cells?', 'Which organelle(s) of a cell are involved in the chemical reaction?', or 'How are carbohydrates broken down in a cell?' The research questions and 'how to modify questions to find answers' will be dealt in level 2 training.

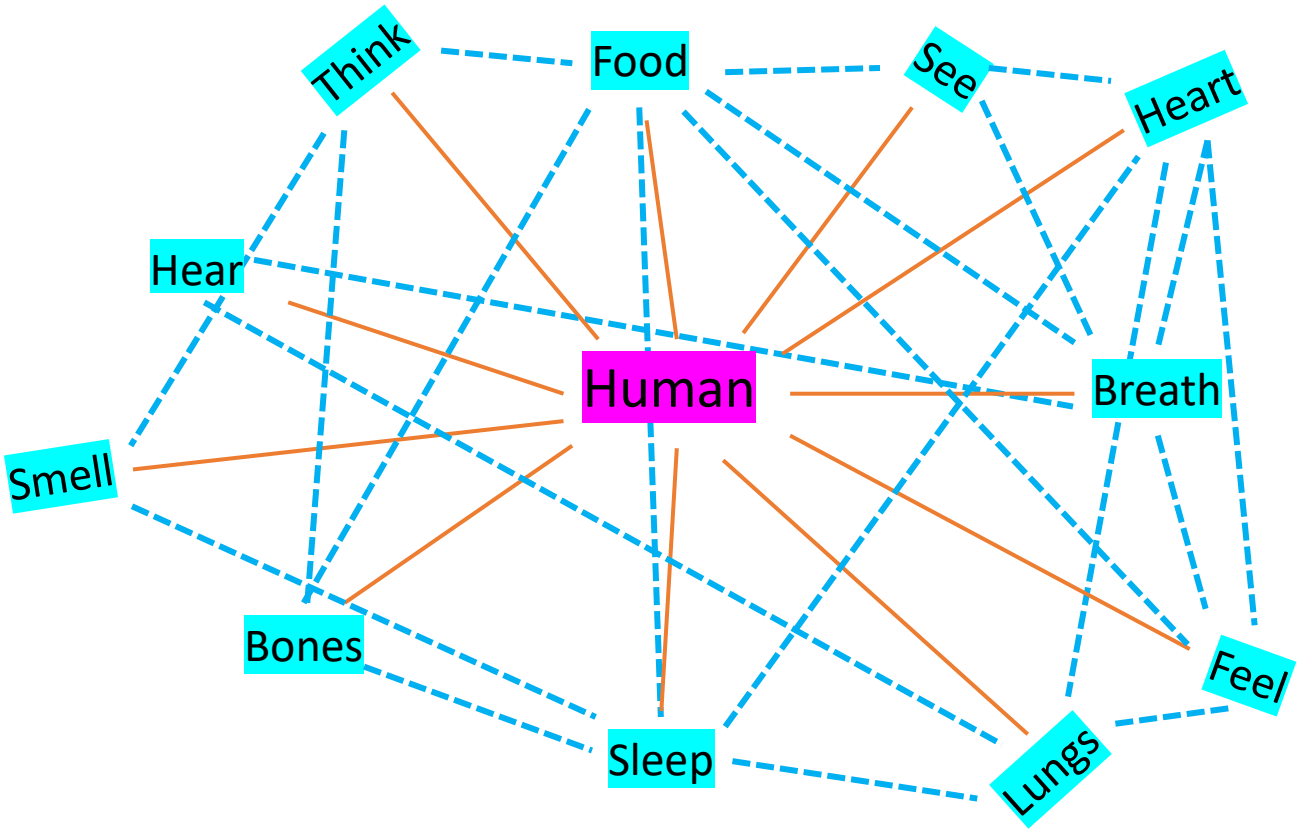
In thought process-based education, comparison is another important skill that needs to be achieved throughout level 1 and 2 training. Comparison is basically an analytical skill that categorizes and visualizes the similarities and differences of data. Finding differences by comparing concepts is more difficult than finding common factors. In this level 1-2 training, the focus is connecting concepts with common factor(s) rather than differences. However, you are encouraged to train yourself to find differences and use them to make research questions.

The term research in thought process-based learning is only applied for the cases when you come up with the questions to do research. The questions that are given by others (teachers, professors, supervisors) are considered as information search or passive findings because it is not you who asked the questions. If you don′t start with your own questions to do research, your brain wouldn′t work proactively unless you are particularly interested in the topic. Remember, if you are using your brain passively, you won′t be able to develop your brain. Besides, artificial intelligences can sometimes perform better on information search or findings since their power to compute and analyze is faster than human and they also have access to the numerous data all over the world.

Step 6. Describe each step as detail as possible and summarize each flowchart separately (e.g. Eating food and breathing separately).

Step 7. Connect, merge and summarize the two descriptions from Step 6 in writing.

Step 8. Continue making connections with other concepts on the list.



Appendix: Expanding concepts with research from the list method (method 1)

In order to expand the concept through research, it is necessary to integrate both 'concept building' and 'concept connection'. Therefore, the concept expansion will be covered in detail in level 2 training of thought process-based learning. In this appendix, only a brief example will be provided as a preview.

Method to expand concepts with research (continuing from step 9 of the list method, page 12)

Step 10. Start with the description created in Step 9

When water evaporates by heat in a lake or sea, it forms clouds....

Step 11. Generate questions using the description from step 10

[Description]

Water evaporates from a lake or sea.

[Questions based on the description]

– What causes water to evaporate?

– Where does the heat come from?

Step 12. Adopt or build (if not done) concepts of evaporate or heat

[Example]

Water is not interacting effectively with visible light physically but is heated by infrared which is also a type of light. The wavelength of infrared is longer than visible light. Given that x-rays are shorter wavelength than visible lights and because of the shorter wavelength, they are considered to have higher energy than visible light. Thus, infrared which is longer wavelength than visible lights, can be considered as the light with lower energy than visible lights.

Step 13. Generate questions using the concept in Step 12

[Example]

How can the infrared (light with lower energy than visible lights) boil the water while visible lights can't?

Step 14. Research to find answers to the question from step 13.

Level 2 training will provide the methods to find answers to the research questions as shown here and previously about interaction between carbohydrate and oxygen in cells.

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