

08 Brainstorm Graphic Organizers

Beyond creating lists of new ideas and concepts, brainstorm graphic organizers help in the creation of new knowledge by visually structuring a deep dive into a problem space.

Brainstorming has traditionally been used to spur group creativity with the intention of generating concepts and ideas regarding a specific challenge. "Go for quantity over quality," "withhold judgment and criticism," "build on each other's ideas," and "welcome oddity" are a few of the widely accepted rules of brainstorming.¹ The intention of these guidelines is to create a safe forum for the expression and free association of creative ideas, and quell any inhibitions of the participants by providing a judgment-free zone to explore new concepts.

More recently, brainstorming is also being used to develop one's fluency of thinking.² Graphic organizers, or visual representations of knowledge, are frameworks that facilitate teams as they challenge assumptions, experiment with new relationships between accepted components of a problem space, and as they consider unconventional alternatives within a domain.

Design teams can visually communicate the rigor required of most brainstorming sessions using the following visualization frameworks:³

Brainstorming Webs Use brainstorming webs when developing a central concept or question and identifying its characteristics, supporting facts, and related ideas. Brainstorming webs can be built by either identifying the center first, then all of the extensions, or by identifying all of the components first, then abstracting them to determine overarching central themes.

Tree Diagrams Use tree diagrams when you need to communicate hierarchy, a classification system, or relationships between main and supporting ideas. Tree diagrams can be constructed from the top down, or from the bottom up. In this way, they require either inductive or deductive thinking while brainstorming a specific topic.

Flow Diagrams Use flow diagrams, or flowcharts, when you need to document a sequence of events, represent the actions or processes of different actors in a system, communicate a process, or show cause and effect of interrelated elements. Flow diagrams usually have a beginning and an end and can support timelines, but they can also be adapted to show cycles for close-looped systems.

The human mind organizes and stores information in a series of networks.⁴ Brainstorming webs, tree diagrams, and flow diagrams are three sense-making frameworks that design teams can use to visually brainstorm information in order to disrupt and challenge old patterns of thinking. By using these frameworks, new knowledge and meaning can emerge, with the added benefit that the rigor of the brainstorming session is visually documented within the framework itself.

1. In 1948, *Your Creative Power* by Alex Osborn was published. The book documented the brainstorming technique that had been used at Osborn's famous ad agency, BBDO, since the 1930s. Brainstorming was further popularized in Osborn's book, *Applied Imagination: Principles and Procedures of Creative Problem-Solving*, 3rd ed. Buffalo, NY: Creative Education Foundation, 1993.

2. Hyerle, David. *Visual Tools for Constructing Knowledge*. Alexandria, VA: ASCD, 1996.

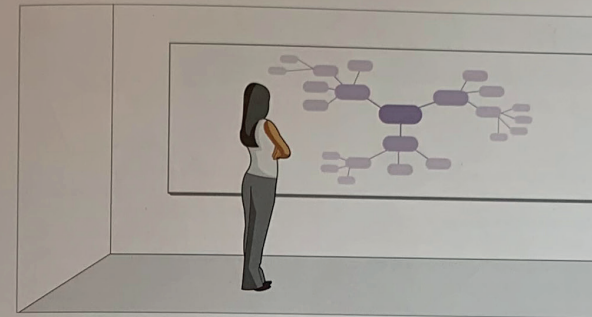
3. See note 2 above.

4. Ausubel, David, Joseph D. Novak, and H. Hanesian. *Educational Psychology: A Cognitive View*, 2nd ed. New York: Holt, Rinehart & Winston, 1978.

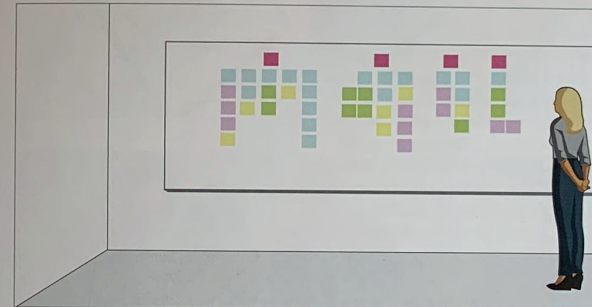
Further Reading

Clarke, John H. *Patterns of Thinking: Integrating Learning Skills in Content Teaching*. Boston, MA: Allyn & Bacon, 1990.

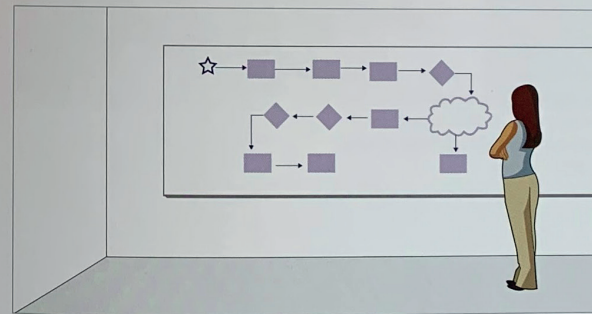
Sinatra, Richard, et al. "Integrating Computers, Reading, and Writing Across the Curriculum." *Educational Leadership* 48 (1990): 57-62.



Brainstorming webs are helpful when developing a central concept or question and its identifying characteristics, supporting facts, and related ideas.



Tree diagrams communicate hierarchy, a classification system, or relationships between main and supporting ideas.



Flow diagrams, or flowcharts, show the actions or processes of different actors in a system, communicate a process, or show cause and effect of interrelated elements within a system.

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See also 12. Cognitive Mapping • 16. Concept Mapping • 56. Mind Mapping

11 Case Studies

The case study is a research strategy involving in-depth investigation of single events or instances in context, using multiple sources of research evidence.¹

Case studies have a long history in social science research, and in the teaching practices of law and business.² More recently, it has been proposed that this method has value for design practice and education, in both the use of case studies for design research and teaching, and in the *writing* of case studies by designers.³ Case studies are useful in exploratory research for understanding existing phenomena for comparison, information, or inspiration, but can also be used to study the effects of change, new programs, or innovations.

The case study method focuses on gaining detailed, intensive knowledge about a single instance or a set of related instances. These instances, or cases, may be of individuals, organizations, entire communities, events, or processes. The details of cases emerge during data collection and analysis, which typically include the following features:⁴

- Selection of a case or small set of cases for a situation or area of concern
- Study of the case in context, in its social and physical setting
- Collection of information using multiple, triangulated methods such as interviews, observations, unobtrusive trace measures, and document analysis

Case studies are inclusive, assuming that consideration of the whole, covering interrelationships, is more advantageous than a reductionist study of parts, and that this depth compensates for any shortcomings in breadth and the ability to generalize. Furthermore, the case study method does not look for representative instances, but welcomes extraordinary cases and outliers. However, descriptions from a single researcher should be cross verified to enhance the reliability of participant accounts, while still recognizing that each individual point of view may be valid. While single cases are not enough to support or reject hypotheses, they may shed light on theory.⁵

Case studies have been proposed as useful for designers, bearing some resemblance to the design process. Case studies require the researcher to determine a problem, make initial hypotheses, conduct research through interviews, observations, and other forms of information gathering, revise hypotheses and theory, and tell a story.⁶ The telling of case studies should in fact be designed, and when well composed, can result in compelling human narratives, meaningful for research yet enjoyable to read, with vivid details that make the case more memorable.⁷ Furthermore, the documenting of design process has the potential to contribute to a repository of design case studies.

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1. Yin, Robert K. *Case Study Research: Design and Methods*, 3rd ed. Thousand Oaks, CA: Sage Publications, 2002.

2. Harvard Law School introduced the concept of case study beginning in the late 1870s, taking advantage of existing cases natural to the practice of law, and in reaction to traditional teaching methods requiring memorization and recall. By the 1920s, the Harvard Business School followed, with the added challenge of writing its own cases. Harvard Medical School introduced the use of case studies in the 1980s. The adoption of case studies as an educational approach fostered in-depth reading of cases, analysis, and the dialectic of classroom discussion. In professional programs, case studies proved to be a needed bridge between the scholarship of theories, and connections to real-life experience to inform decision making. See:

Breslin, Maggie, and Richard Buchanan. "On the Case Study Method of Research and Teaching in Design." *Design Issues* 24, no. 1 (Winter 2008): 36-40.

3. Breslin, Maggie, and Richard Buchanan. "On the Case Study Method of Research and Teaching in Design." *Design Issues* 24, no. 1 (Winter 2008): 36-40.

4. Robson, Colin. *Real World Research: A Resource for Social Scientists and Practitioner-Researchers*, 2nd ed. Oxford: Blackwell Publishers, 2002.

5. Sommer, Robert, and Barbara Sommer. *A Practical Guide to Behavioral Research: Tools and Techniques*. New York: Oxford University Press, 2002.

6. See note 3 above.

7. See note 5 above.



See also 35. Evidence-based Design • 70. Research Through Design • 74. Secondary Research

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12 Cognitive Mapping

Cognitive mapping is a visualization of how people make sense of a particular problem space. It is most effective when used to structure complex problems and to inform decision making.¹

Cognitive mapping is an information visualization technique that can be used as a decision- and sense-making tool. Its purpose is to reveal how people think about a problem space, and visualize how they process and make sense of their experience. As the map builds, the participant's subjective patterns of reasoning can be revealed and the underlying nature of the problem exposed.

Like concept maps and mind maps, cognitive maps are visual-thinking tools that represent a network of ideas and associations. All three are used to organize a complicated (and usually messy) information space so that the relationships between concepts can be identified, more fully explored, shared, and reflected upon. However, even though similarities exist across visual-thinking techniques, cognitive maps have a few distinctive qualities. Primarily, cognitive maps were designed specifically as a decision-making tool that can inform strategic direction.² The format and structure require no central node (or concept) that works as the focus of the visualization, and they rarely include imagery. Instead, the nodes of a cognitive map are made up of the exact words and phrases spoken by participants.

Each node can have as many incoming and outgoing associations as necessary, and this flexibility is how the most salient concepts are quickly identified.³ The nature of the links in a cognitive map communicate cause and effect. They are to be read as *node x may lead to node y* or *node x may imply node y*. Another attribute specific to cognitive maps is that concepts can be monopolar or bipolar, which allows for the expression of nuance and "shades of gray."⁴ As these poles often represent significant issues or choices, the ability to visually connect them is a powerful means of considering the range of challenges associated with a problem space.⁵

Cognitive mapping can facilitate the note-taking process during interviews, and when transcribing text-based qualitative data. Cognitive mapping gets easier with experience, and novice mappers should try practicing the technique using existing transcripts or taped interviews before applying it in the field.⁶ The technique has been used for agenda and strategy development,⁷ and when "group" maps are produced that weave together multiple points of view, the maps can serve as a powerful consensus-making tool. The guidelines around building cognitive maps are purposely written to remain flexible. The use of the tool can be considered successful when it provides a scaffolding to think about, explore, and create new constructs of meaning that help people and groups achieve problem resolution.

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1. The cognitive mapping technique is grounded in George Kelly's personal construct theory. Personal construct theory holds that in an attempt to anticipate and predict future events, humans make sense of the world by creating subjective classifications-or personal constructs. By differentiating concepts, we create meaning, and can intervene as necessary to get what we want from the world-a "predict and control" view of how the world works. See George Kelly's two-volume opus:

Kelly, George. *The Psychology of Personal Constructs (Volumes 1 and 2)*. New York: Norton, 1955.

2. For an explanation of how to codify text-based documents and create cognitive maps, see:

Ackermann, Fran, Colin Eden, and Steve Cropper. "Getting Started with Cognitive Mapping" in *The Young OR Conference, University of Warwick, 1992*: 65-82.

Eden, Colin, and Fran Ackermann. *Making Strategy: The Journey of Strategic Management*. Thousand Oaks, CA: Sage Publications, 1998.

3. "What's In A Name? Cognitive Mapping, Mind Mapping, Concept Mapping," www.banxia.com.

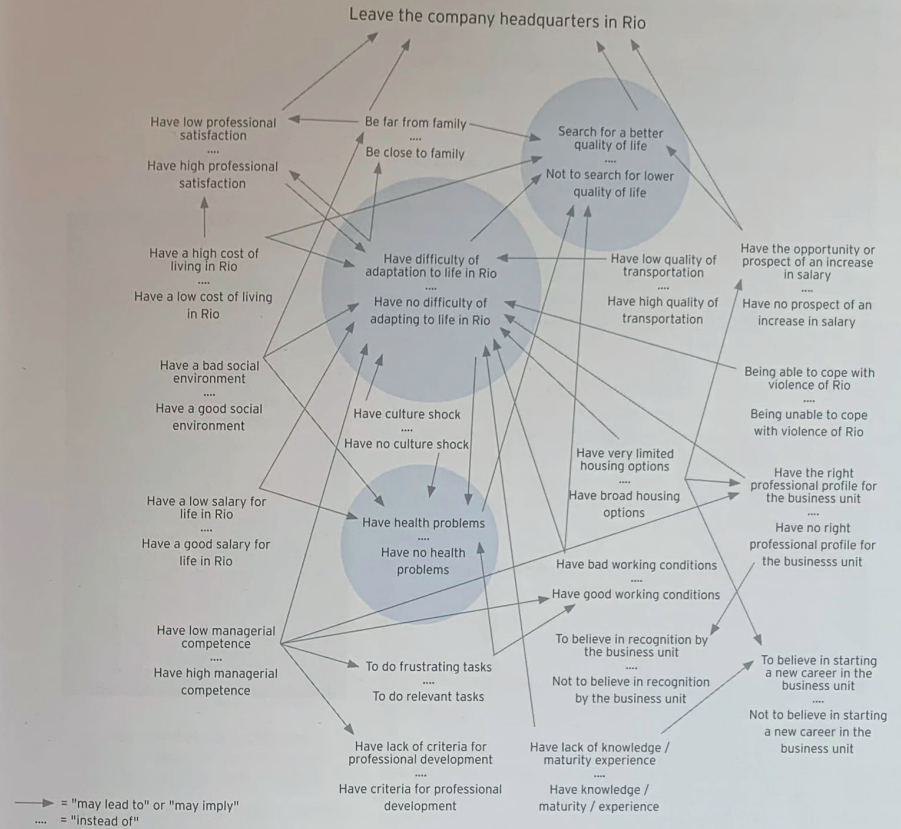
4. See note 3 above.

5. See note 2 (Ackermann, Eden, and Cropper) above.

6. See note 2 (Ackermann, Eden, and Cropper) above.

7. See note 2 (Eden and Ackermann) above.

8. Gomes, Luiz Flávio Autran Monteiro, Luis Alberto Duncan Rangel, and Rogério Lúcio Jeronimo. "A Study of Professional Mobility in a Large Corporation Through Cognitive Mapping." *Pesquisa Operacional* 30, no. 2 (2010): 331-344.



Cognitive maps reveal people's underlying agendas and decision-making criteria. Researchers in Rio constructed this cognitive map based on questionnaire responses of employees who are considering leaving a company headquarters in Rio to return to their Brazilian state of origin. The most salient concepts are the ones with the most connections to other concepts.⁹

Cognitive Map courtesy of Luiz Flávio Autran Monteiro Gomes, Luis Alberto Duncan Rangel, and Rogério Lúcio Jeronimo

See also 17. Content Analysis • 48. Interviews • 39. Exploratory Research

RESEARCH METHOD

14 Collage

As inspiration for design teams, collage allows participants to visually express their thoughts, feelings, desires, and other aspects of their life that are difficult to articulate using traditional means.¹

When prompted by traditional research methods such as questionnaires and interviews, people often find it challenging or uncomfortable to articulate and express their innermost feelings, thoughts, and desires. Collage can help mitigate this challenge, by providing an opportunity for research participants to project personal information onto visual artifacts, then using these results as a tangible reference point for conversation.

A collage kit typically includes card or paper sheets, a preset collection of images, words, and shapes, and glue sticks. Recent studies have also experimented with screen-based collage sessions using custom-made software.² Collages are each completed by a single person, but sessions are generally conducted in small groups. A critical component is to have participants present their collages to the group or researcher, to provide clarity and insight about image choices and meaning. Presentations are videotaped for later analysis of footage or transcripts.

Collage is usually instructed openly to allow for participant interpretations. For example, participants may be invited to collage their view on some phenomena (technology, information), or their feelings about particular service experiences (hospital, finances), or their home or work life. A common framework is to include time dimensions to the collage instructions, for instance, experiences past, today, and in an ideal future. Participants may be provided with a blank paper canvas on which to create their collage, or it may have general frames or lines to suggest placing words and images above or below a line, along an axis, or within or outside a shape or outlined object.

The challenge for designers in creating collage kits is to find the right quantity and level of specificity in images and words—ambiguous enough so that they do not bias the participant, yet specific enough to be relevant to the topic being collaged. Blank frames or stickers should be provided, and markers to add participants' own material to the collage.

Qualitative analysis is used to look for patterns and themes within and across several collages. Coding may include the use or nonuse of particular images, words, and shapes, negative and positive use of elements, position of elements on the page, and the relationship between elements. To obtain a level of objectivity and rigor in the analysis, collage interpretations may be compared between the facilitators who attended the session and those who were not there; by individually interpreting collages and then discussing them in design teams; and by analyzing the visual artifact with and without the transcript of the participant.

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1. Creative, participatory tools for design, including collage, have been pioneered by Liz Sanders. See, for example:

Sanders, Elizabeth B.-N., and Colin T. William. "Harnessing People's Creativity: Ideation and Expression through Visual Communication" *Focus Groups: Supporting Effective Product Development*. London: Taylor and Francis, 2001.

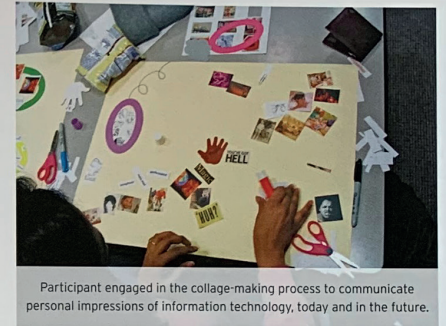
See additional readings from research and practice at <http://www.maketools.com>.

2. Stappers, Pieter Jan, and Elizabeth B.-N. Sanders. "Generative Tools for Context Mapping: Tuning the Tools" in *Design and Emotion: The Experience of Everyday Things*. London: Taylor & Francis, 2003: 85-89.

Collage allows participants to project their thoughts, feelings, and desires onto a visual artifact, providing insight and inspiration for design teams.



Participants working with various collage materials.



Participant engaged in the collage-making process to communicate personal impressions of information technology, today and in the future.



A finished collage.

See also 21. Creative Toolkits • 44. Generative Research • 61. Participatory Design

16 Concept Mapping

Concept mapping is a visual framework that allows designers to absorb new concepts into an existing understanding of a domain so that new meaning can be made.¹

A concept map is a sense-making tool that connects a large number of ideas, objects, and events as they relate to a certain domain. It provides a scaffolding that can help designers visualize the complexities of a system, and assists them as they make and break connections, study existing connections, and expand on what is already understood but possibly taken for granted within a particular system.

Concept maps consist of individual concepts (a well-understood idea, object, or event; usually a noun or noun cluster) connected by linking words (usually a verb). When linking words connect two or more concepts, a proposition is formed that creates a meaningful statement. As propositions emerge, some relationships may reflect knowledge that is already understood, but others will represent new knowledge.² The power of the concept map is that it brings new connections into focus within the context of already understood information. As new insights are formed, designers can study relationships between old and new concepts, revealing new meaning as it relates to the domain.

To construct a concept map, it is important to have a good understanding of the domain. If one's understanding of the concepts is limited, it will be difficult to make meaningful interconnections with linking words.³ Also, articulating the correct focus question is a key step that will provide context and structure to the map. "How do people share pictures" and "How do people want to share pictures" should lead to different maps: the former providing a listing of options, the latter, a more exploratory audit suggesting a range of opportunities.

After a focus question is generated, a list of fifteen to twenty-five concepts should be identified and ranked from general to very specific, as they relate to the focus question. Successful concept maps are organized hierarchically based on this ranking, even if it is just a loose organization at first. Once all of the concepts are ranked, the next step is to initiate the construction of a preliminary map using either paper-based or computer-based tools that make it easy to move concepts around. Ideally, the concepts can be moved around by trial and error until the best hierarchy is reached.

Once a strong map is in place, cross-links identify relationships between subdomains in the map, and linking words articulate individual concepts. This can be the most difficult step for the mapmaker.⁴ Finally, revise, reposition, and rewrite until a final map emerges that adequately answers the focus questions. Maps that meet the above criteria should help design teams gain new knowledge, and find new meanings in an information space.

1. While researching how children learn new concepts and information, David Ausubel determined that learning is more meaningful when new information is assimilated into existing frameworks that children already grasp. While seeking a better way to represent the learning process, what emerged was the idea of visually representing children's knowledge in the form of a concept map. See:

Ausubel, David P. *The Psychology of Meaningful Verbal Learning*. New York and London: Grune and Stratton, 1963.

2. Ausubel, David, Joseph D. Novak, and H. Hanesian. *Educational Psychology: A Cognitive View*, 2nd ed. New York: Holt, Rinehart & Winston, 1978.

3. See note 2 above.

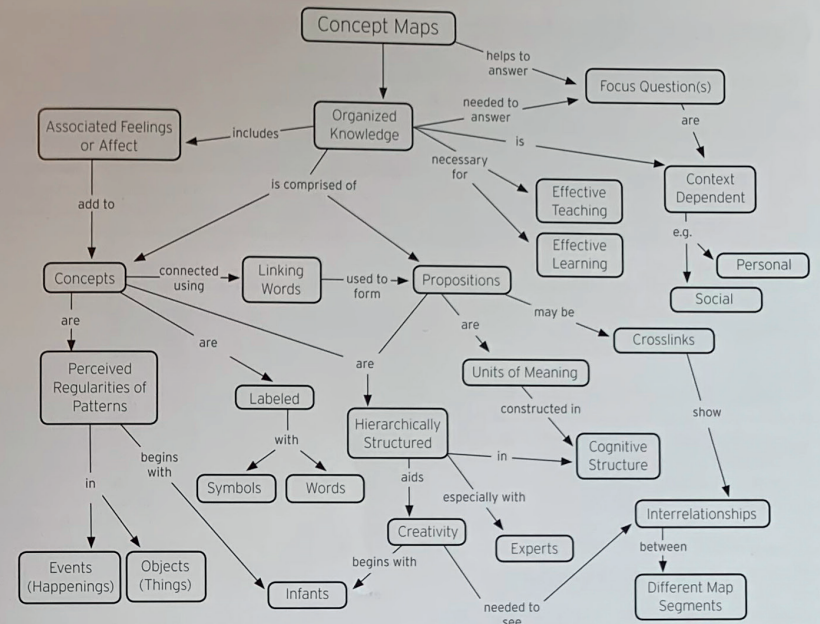
4. See note 2 above.

5. Novak, J. D., and A. J. Cañas. "The Theory Underlying Concept Maps and How to Construct and Use Them" in *Technical Report IHMC CmapTools 2006-07 Rev. 01-2008*, Florida Institute for Human and Machine Cognition, 2008. <http://cmap.ihmc.us/Publications/ResearchPapers/TheoryUnderlyingConceptMaps.pdf>
CmapTools, a knowledge modeling kit that is designed to construct concept maps, is available online at cmap.ihmc.us.

Further Reading

Novak, Joseph D., and D. Bob Gowin. *Learning How to Learn*. Cambridge: Cambridge University Press, 1984.

Preszler, R. W. "Cooperative Concept Mapping Improves Performance in Biology." *Journal of College Science Teaching* 33 (2004): 30-35



Concept maps are organized in a downward hierarchy, with the focus question at the top of the map and the most general concepts below it.

Concepts are well-understood ideas, objects, or events, connected by linking words. When linking words connect two or more concepts, a proposition is formed that potentially challenges existing thinking or creates new meaning.⁵

Courtesy of Joseph D. Novak and Alberto J. Cañas. <http://cmap.ihmc.us>

See also 08. Brainstorm Graphic Organizers • 12. Cognitive Mapping • 56. Mind Mapping

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56 Mind Mapping

When a topic or a problem has many moving parts, mind mapping provides a method of visually organizing a problem space in order to better understand it.

Mind mapping is a visual thinking tool that can help generate ideas and develop concepts when the relationships among many pieces of related information are unclear. It provides a nonlinear means of externalizing the information in our heads so that we can consolidate, interpret, communicate, store, and retrieve information. Because of its visual, diagrammatic nature, it is a powerful mnemonic device, and can be used to promote understanding and enhance recall of a problem space.

Because the way people think is rarely linear, and complicated problems do not follow a neat pattern of steps that can be isolated from one another, mind maps reflect how we think through complexities of a given problem. As the map takes shape, it allows us to summarize and test assumptions, make and break connections, and consider alternatives while we shape the data into meaningful themes and patterns.

By limiting mind maps to one side of one sheet of paper, the process of freely mapping associations should not feel overwhelming. To draw a mind map, follow the steps below:¹

1. Identify a focus question to serve as the central theme and keep the mapping process from straying off topic. Draw the subject in the center of a sheet of paper, and circle it.
2. Start drawing extensions outward from the center of the map, and label them with simple verb-noun pairs or noun clusters. The closer a word or image is to the center, the more importance it takes on in your map. These are your primary connections.
3. As the spokes of primary connections are identified, each will reveal deeper, more granular levels of secondary information. Connect primary and secondary connections with lines. It is the connections of concepts that create meaning.
4. Continue this process of making free associations until all relevant pieces of information are represented. As new information comes up, add it to the map.
5. Before declaring the map complete, stay with it for a while. The idea is to strengthen concepts and their interconnections with hopes of creating new knowledge and understanding.

By providing people a means to visually represent their unique thinking patterns in a nonlinear, visual way, researchers can better understand different ways that people prioritize and organize information. After the map is complete, have the user explain the pieces of the map, and its meanings. When mind mapping is used in this manner, it would fall under a "self-reporting" method, and should be further vetted with additional observation-based research. Nonetheless, it can be used to reveal basic, idiosyncratic patterns of thinking.²

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1. Hyerle, David. *Visual Tools for Constructing Knowledge*. Alexandria, VA: ASCD, 1996.

2. See note 1 above.

3. See note 1 above.

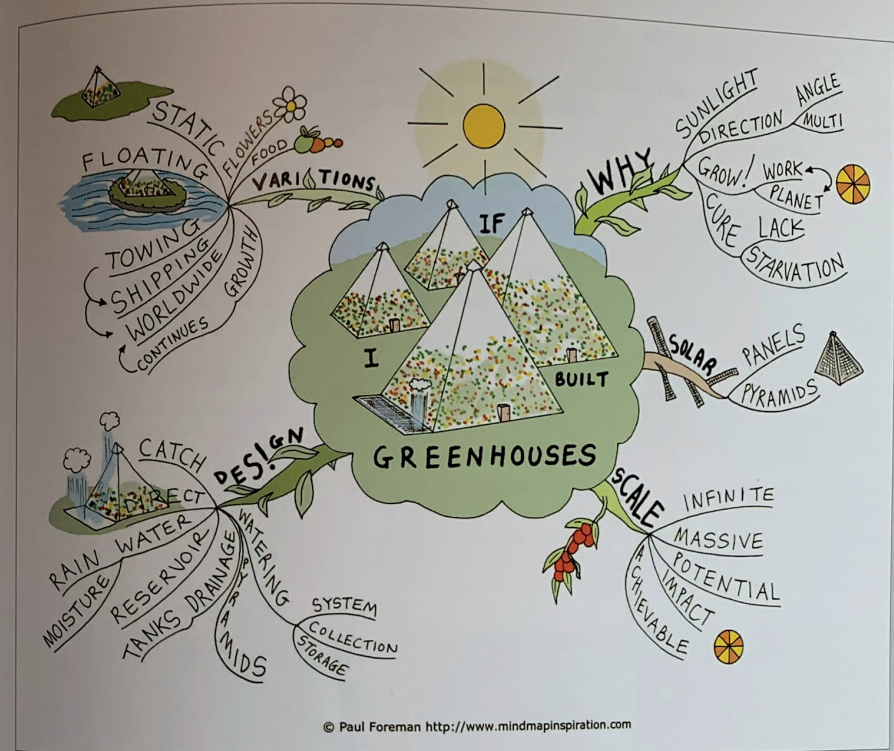
Further Reading

Buzan, Tony. *The Mind Map Book*. New York: Plume, 1996.

Buzan, Tony. *Use Both Sides of Your Brain*, 3rd ed. New York: Plume, 1991.

Wycoff, Joyce. *Mindmapping: Your Personal Guide to Exploring Creativity and Problem-Solving*. New York: Berkley Books, 1991.

See www.mindmapinspiration.com.



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When used as a method of analysis and sense-making, mind mapping allows us to simultaneously identify the subject of the map, relationships between the components, and understand the relative importance of the information that is represented. The ability to understand the boundaries, and at the same time understand the interconnecting parts within the system, reflects our human capacity for systems thinking at work.³

Use single words or simple noun clusters, common symbols, hand-drawn images, and group-related information with starbursts or clouds. These visual cues serve to transform the map to a mnemonic device that can more readily trigger recall of the information space.

See also 08. Brainstorm Graphic Organizers • 14. Collage • 16. Concept Mapping