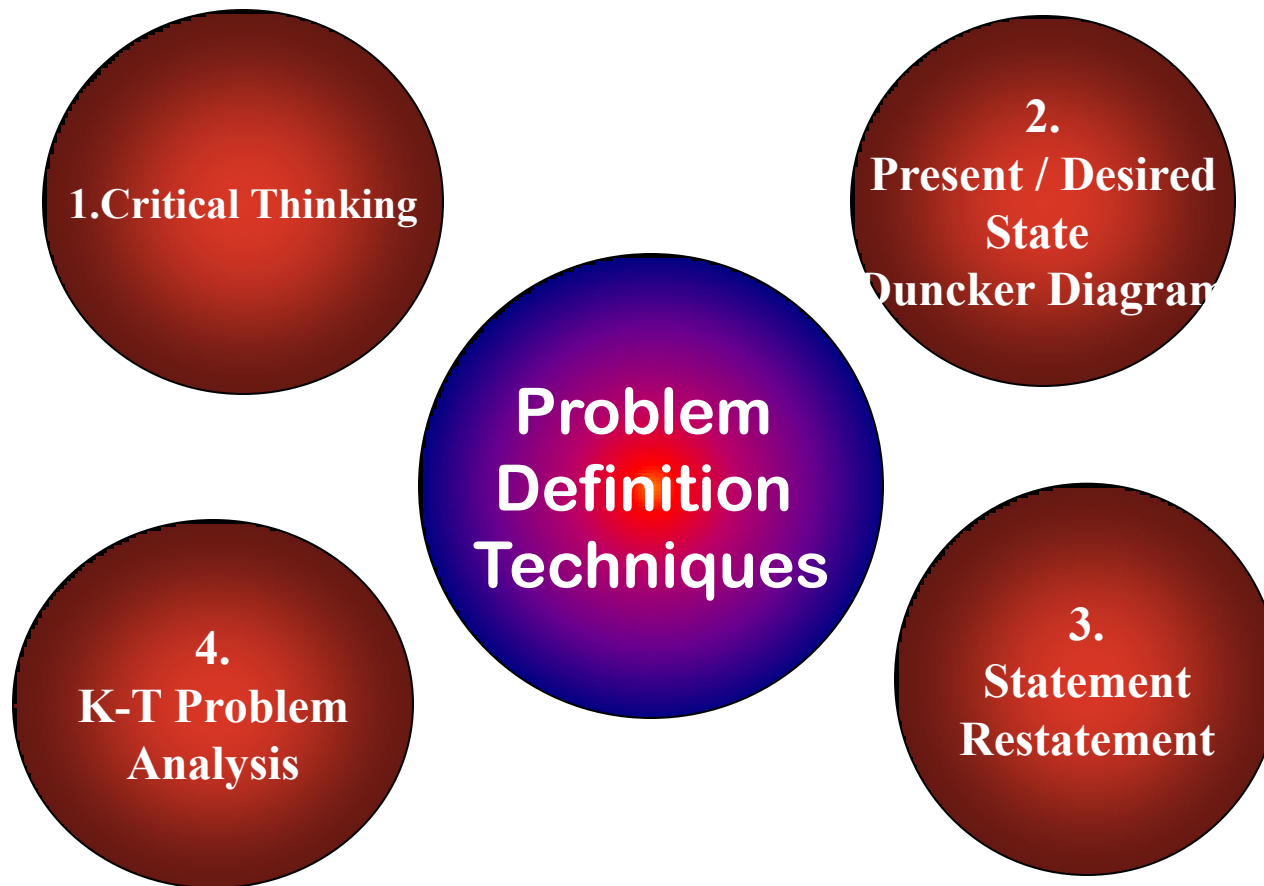
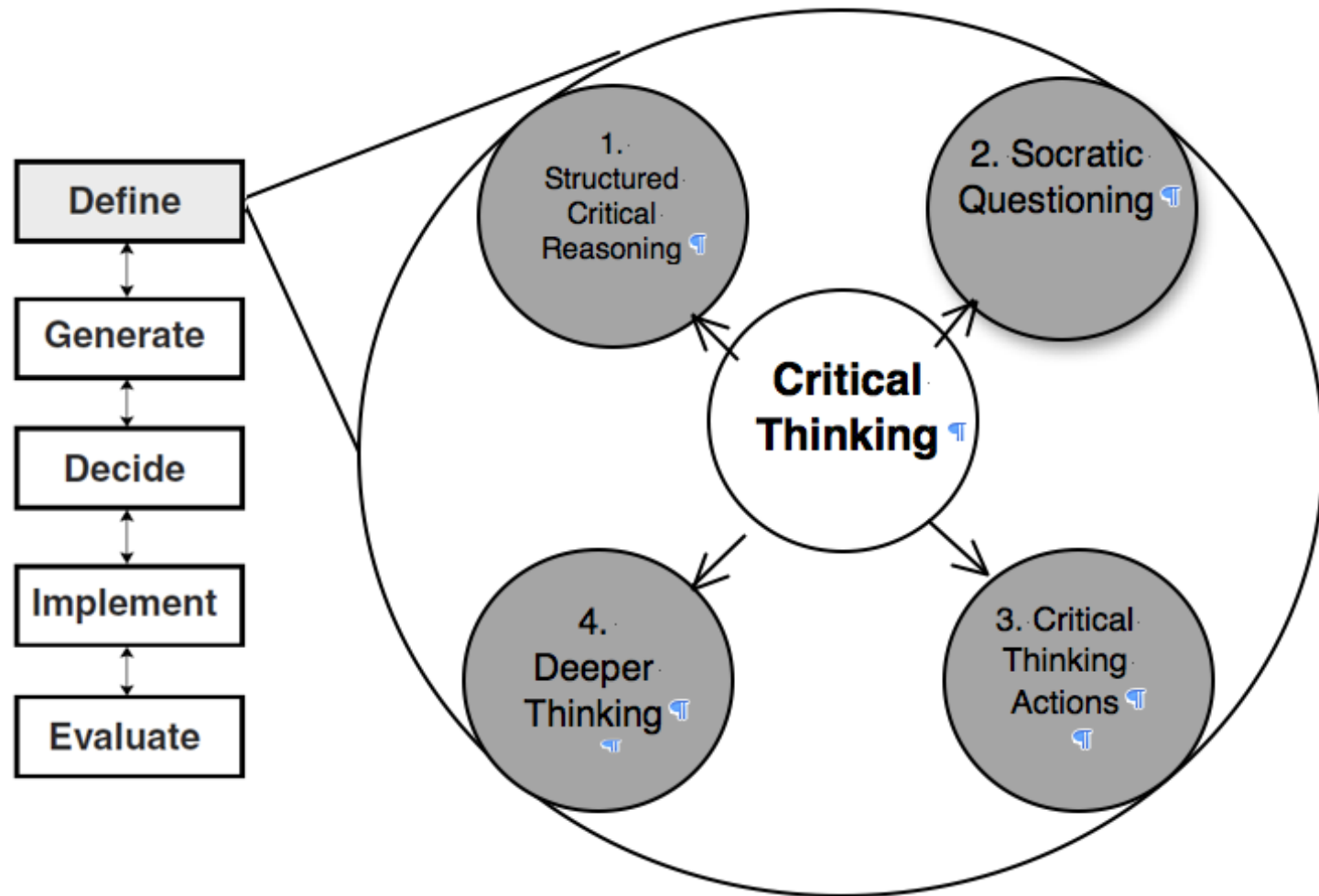


Problem Definition Techniques





Critical Thinking

The process we use to reflect on, assess and judge the assumptions underlying our own and others ideas and efforts.

Determines how skillfully someone gathers, processes and applies information in order to identify the best way to reach a goal or navigate a complex situation.

Socratic Questioning is at the Heart of Critical Thinking

Critical Thinking

1. Questions about the question or problem statement:

The purpose of this question is to find out why the question was asked, who asked it and why the question or problem needs to be solved.

Critical Thinking

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The purpose of this question is to find out why the question was asked, who asked it and why the question or problem needs to be solved.

- What was the point of this question?
- Why do you think I asked this question?
- Why is it important you learn the answer to that question?
- How does this question relate to our discussion?

Critical Thinking

2. Questions for clarification:

The purpose of this question is to find missing or unclear information in the problem statement question.

Critical Thinking

2. Questions for clarification:

The purpose of this question is to find missing or unclear information in the problem statement question.

- What do you mean by that?
- Why do you say that?
- How does that relate to our discussion?
- What do we already know about that?

Critical Thinking

3. Questions that probe assumptions:

The purpose of this question is to find out if there are any misleading or false assumptions.

Critical Thinking

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The purpose of this question is to find out if there are any misleading or false assumptions.

- What could we assume instead?
- How can you verify or disapprove that assumption?
- Explain why. . . (Explain how. . .)
- What would happen if. . . ?

Critical Thinking

4. Questions that probe reasons and evidence:

The purpose of this question is to explore whether facts and observations support an assertion.

Critical Thinking

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The purpose of this question is to explore whether facts and observations support an assertion.

- What would be an example?
- Why is . . . happening?
- What is analogous to. . . ?
- What do you think causes. . . ? Why?
- What evidence is there to support your answer?

Critical Thinking

5. Questions about viewpoints and perspectives:

The purpose of this question is to learn how things are viewed or judged and to consider things not only in a relative perspective, but also as a whole.

Critical Thinking

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The purpose of this question is to learn how things are viewed or judged and to consider things not only in a relative perspective, but also as a whole.

- What is a counterargument for. . . ?
- What are the strengths and weaknesses of that viewpoint?
- What are the similarities and difference between. . . and. . . ?
- Compare. . . and. . . with regard to. . .

Critical Thinking

6. Questions that probe implications and consequences:

The purpose of this question is to understand the inferences or deductions and the end result if the inferred action is carried out.

Critical Thinking

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The purpose of this question is to understand the inferences or deductions and the end result if the inferred action is carried out.

- What are the consequences of that assumption?
- Why is. . . important? (e.g., temperature?)
- Is there a more logical inference we might make in this situation?
- How are you interpreting her behavior? Is there another possible interpretation?
- How did you reach that conclusion?
- Given all the facts, what is the best possible conclusion?

Critical Thinking

R.W. Paul's 9 Types of Socratic Questions

- 1) Questions for Clarification:**
- 2) Questions that Probe Assumptions:**
- 3) Questions that Probe Reasons and Evidence:**
- 4) Questions about Viewpoints and Perspectives:**
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- 8) Questions that Probe Purpose:**
- 9) Questions that Probe Inferences and Interpretations:**

THE CASE OF THE HUNGRY GRIZZLY BEAR

OR

AN EXERCISE IN DEFINING THE “REAL PROBLEM”

1. *Questions for clarification*
2. *Questions about the question*
3. *Questions that probe assumptions*
4. *Questions that probe reasons and evidence*
5. *Questions about viewpoints and perspectives*
6. *Questions that probe implications and consequences*



Question for clarification:

Does this type of bear eat humans?

Answer: Yes.

Question about viewpoints:

Is the bear hungry?

Answer: Yes.

Question probing assumptions:
after eating one person?

Can we assume that the bear will stop

Answer: Yes.

Real problem statement: Having to outrun the other person.

Concerns about a new energy drink

A new energy drink is on the market that combines vitamins with staying alert power, while other energy drinks contain no vitamins. The company said the new drink had all the daily requirement of vitamins needed to stay healthy and feel energized. The drink's ability to keep people awake works especially well for college age adults and pretty well for older adults. A study shows no harmful effects were observed in the vast majority of test subjects. While slightly more expensive than the other energy drinks, it is well affordable to those who need it.



Questions for Clarification

Here we see a number of ambiguous words or phrases.

- How are you defining “staying alert” power?



Questions for Clarification

Here we see a number of ambiguous words or phrases.

- How are you defining “staying alert” power?
- What “harmful effects” was the study looking for?
- What does “feel energized” mean?
- What is a “vast majority”?
- What does “slightly more expensive” mean?
- What is “well affordable”?



Questions about the question

- Why do we need to add to the cost by adding vitamins to the energy drink?
- Is there room or market for *another* energy drink?
- How many of the test market cases caused a harmful effect and what was the effect?



Questions about the question

- Why do we need to add to the cost by adding vitamins to the energy drink?



Questions that probe assumptions

- Will consumers believe that the new drink is safe because the “vast majority” suffered no harmful effects”?



Questions that probe assumptions

- Will consumers believe that the new drink is safe because the “vast majority” suffered no harmful effects”?
- Do consumers perceive that they need another source of vitamins?
- Are the consumers willing to pay the cost differential for the new drink?



Questions that probe reasons and evidence

- What marketing data do you have that suggest consumers will want vitamins in their drink?
- What would be an indication that the consumers are getting greater benefits from the new drink?



Questions that probe viewpoints and perspectives

- What are the most positive and negative consequences of bringing the new energy drink to the market?



Questions that probe viewpoints and perspectives

- What are the most positive and negative consequences of bringing the new energy drink to the market?
- How does the new drink compare with similar drinks on the market?
- What are the advantages and disadvantages of the product over products now on the market?

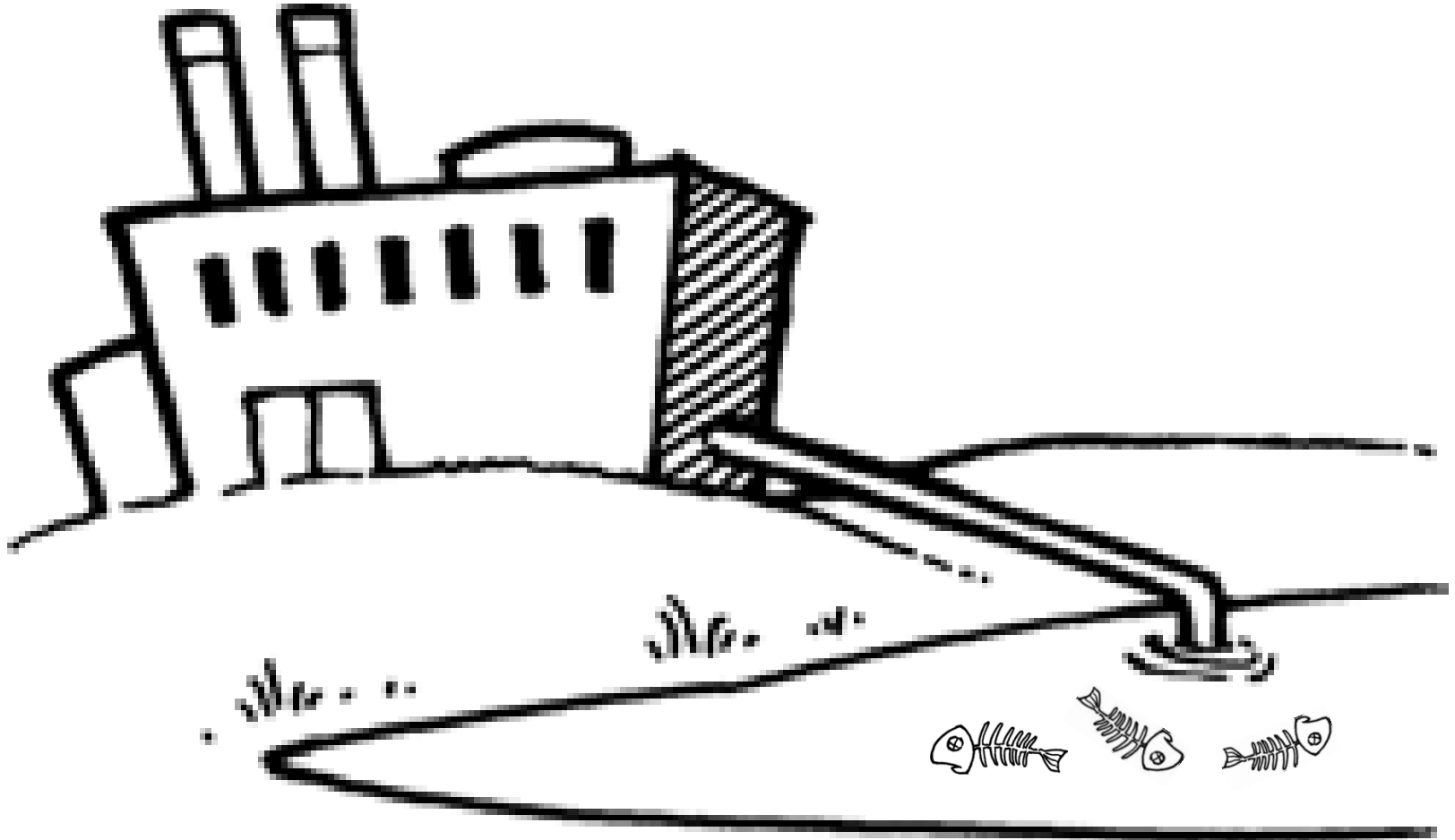


Questions that probe implications and consequences

- Why is the drink not as effective in energizing older adults?
- If someone takes their own vitamin supplements every morning, is there a danger of taking too many vitamins in one day?



Finding Out Where the Problem Came From



The Case of the Dead Fish



The Situation: Stan Wilson is an engineer with six years of experience with his company. The instruction given by Stan's supervisor to solve the perceived problem:

“Design a new waste treatment plant to reduce the toxic waste from the chemical plant.”

Stan and his team are requested to design treatment facilities to reduce the chemical concentrations by a factor of 10. A quick back-of-the-envelope calculation shows that the plant could cost well over a million dollars.

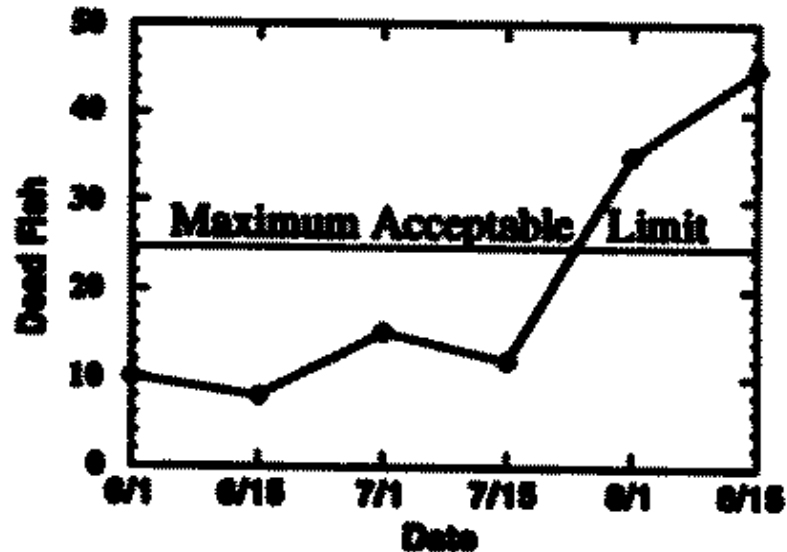
Stan is puzzled because the concentrations of toxic chemicals have always been significantly below governmental regulations and company health specifications.

Finding Out Where the Problem Came From

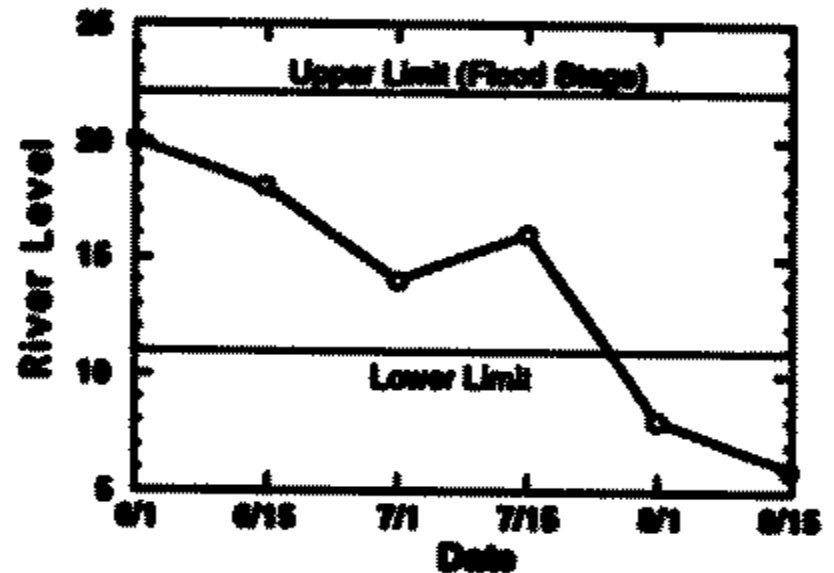
The Case of the Dead Fish



Number of Dead Fish Each Day



River Level Each Day



Finding Out Where the Problem Came From

Questions about the Question:

Q. Stan asks who posed the problem in the first place?

A. Supervisor says upper management.

Finding Out Where the Problem Came From

Questions about the Question:

- Q. Stan asks who posed the problem in the first place?
- A. Supervisor says upper management.

Questions for Clarification:

- Q. Stan asks his supervisor if he can explain how did the problem originated?
- A. His supervisor says from bad publicity in the newspapers about dead fish in the river being attributed to toxic chemical release.

Finding Out Where the Problem Came From

Questions about the Question:

- Q. Stan asks who posed the problem in the first place?
- A. Supervisor says upper management.

Questions for Clarification:

- Q. Stan asks his supervisor if he can explain how did the problem originated?
- A. His supervisor says from bad publicity in the newspapers about dead fish in the river being attributed to toxic chemical release.

Questions that Probe Assumptions:

- Q. Stan asks his supervisor “ Why do think the fish are dying of the toxic chemical release now when there were no dead fish in the river 4 months ago?”
- A. Supervisor explains that fish are dying due to low water level as a result of the drought. Toxic chemicals become more concentrated when the discharge is the same and the water level is lower.

Finding Out Where the Problem Came From

Questions that Probe Reasons and Evidence:

- Q. Stan asks “Was the concentration of chemical in the river was approaching the LD50 level. (LD50 means that 50% of the fish will die at this concentration)?
- A. Stan is informed that the concentration in the river was never measured.

Finding Out Where the Problem Came From

Questions that Probe Reasons and Evidence:

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Questions About the Viewpoints and Perspective

- Q. Is there is an alternative explanation as to why the fish are dying other than a toxic chemical release? Would someone with a biological background have a different interpretation?
- A. Stan decides to call a biology professor he knows.

Finding Out Where the Problem Came From

Questions that Probe Reasons and Evidence:

- Q. Stan asks “Was the concentration of chemical in the river was approaching the LD50 level. (LD50 means that 50% of the fish will die at this concentration)?
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Questions About the Viewpoints and Perspective

- Q. Is there is an alternative explanation as to why the fish are dying other than a toxic chemical release? Would someone with a biological background have a different interpretation?
- A. Stan decides to call a biology professor he knows.

Questions About the View Points and Perspective

- Q. Stan wonders if there is an alternative explanation as to why the fish are dying and calls a biology professor he knows?
- A. She explains that the low water levels and higher water temperatures make fish more susceptible to disease, perhaps fungus.

Finding Out Where the Problem Came From

Questions that Probe Implications and Consequences:

- Q. Stan wonders if there could be other locations in the area where fish are dead or sick, (upstream) of the plant, surrounding lakes and rivers where the toxic chemicals were not present. He calls the state department of natural resources (DNR).
- A. Government official at DNR says dead fish have been found upstream of the plant.

Stan knows that there is no way the toxic chemicals could diffuse upstream of the chemical plant with the river current the way it is.

Questions that Probe Reason and Evidence:

- Q. Stan asks Michigan's DNR if they could check to see if there are dead/infected fish in areas other than the river?
- A. Upon checking the DNR database it was revealed that dead fish were also found in nearby lakes.

Finding Out Where the Problem Came From

Questions about the Question:

Q. Have the questions been answered?

Stan calls DNR and asks if they had the results of tests from the dead fish

A. The dead fish both the river and the lakes were analyzed and found to contain the a fungus that was causing them to die.

Epilogue

Stan was praised by his management for finding the real problem so that the company did not go ahead and try to solve the perceived problem by building the multimillion dollar plant.

Critical Thinking Actions

- **Applying Standards:** judging according to established personal, professional, or social rules or criteria
 - “I rank ordered the various...”
 - “I grouped things together”
- **Analyzing:** separating or breaking a whole into parts to discover their nature, function and relationships
 - “I studied it piece by piece”
 - “I sorted things out”
- **Information seeking:** searching for evidence, facts, or knowledge by identifying relevant sources
 - “I knew I needed to lookup/study...”
 - “I kept searching for data on

Critical Thinking Actions

- **Logical Reasoning:** drawing inferences or conclusions that are supported by evidence
 - “I deduced from the information that...,”
 - “My rationale for the conclusion was...”
- **Predicting:** envisioning a plan and its consequences.
 - “I envisioned the outcome would be...,”
 - “I was prepared for...”
- **Transforming Knowledge:** changing or converting the condition, nature, form, or function of concepts among contexts.
 - “I improved on the basics by...,”
 - “I wondered if that would fit the situation of ...”

Fires in Orange County

In the following situation define the Mayor's perceived problem.

In Orange County, Calif., only 2% of firefighter emergency responses involve fires, the rest are car accidents, fender benders, bicycle accidents, and other small medical emergencies. This unnecessary deployment of firefighters wastes money by sending gas guzzling fire trucks and full fire crews to situations they are not needed. The Mayor responds to this data stating that because firefighters are out at the streets on non-fire emergencies, they don't receive the calls and therefore don't respond to many fires in the county. He adds that new fire stations and detection systems should be implemented throughout the region.

- a) Carry out a structured critical reasoning on this situation.
- b) What is the perceived problem.
- c) Ask one of each of the type of Socratic questions about the Mayor's Perceived Problem.
- d) Identify the mayor's real problem.

Fires in Orange County

Question for clarification:

How does number of fires relate to fire fighters other responses?

Question that probes assumptions:

How could we prove there are more fires for the fire fighters to respond to?

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Question that probes reasons and evidence:

What evidence exists that there are fires not being responded to?

Question about viewpoint and perspective:

Could we view a low percentage of responses being to fires as a high percentage of responses being to medical emergencies?

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What evidence exists that there are fires not being responded to?

Question about viewpoint and perspective:

Could we view a low percentage of responses being to fires as a high percentage of responses being to medical emergencies?

Question about the question:

Why does it matter what the firefighters are responding to?

Questions that probe implications and consequences:

What would it matter if the firefighters were only responding to fires?

Critical Thinking

R.W. Paul's 9 Types of Socratic Questions

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