Gathering Information on the Problem

Slides mainly adapted from Dr. Fogler's "Strategies for Creative Problem Solving" book

Problem Solving in the Large

- In-the-small
  - There is an answer, the problem is to find it.
- In-the-large
  - Many possible solutions.
  - More complex problems -> more alternative solutions.
  - The goal is to pick the best solution.

Problem Solving Process

- Define the problem
- Generate solutions
- Analysis for deciding the course of action
- Implement the solution
- Evaluation

Problem Definition

- The first step is to define the “right problem”.
  - Often the hardest/most important step
- The “real problem” is often disguised.
- Symptoms vs. root problem

- Example 1:
  - Store had a rain forest health food mix.
  - It didn’t sell.
  - Perceived problem: overpriced.
  - Real problem: badly displayed.

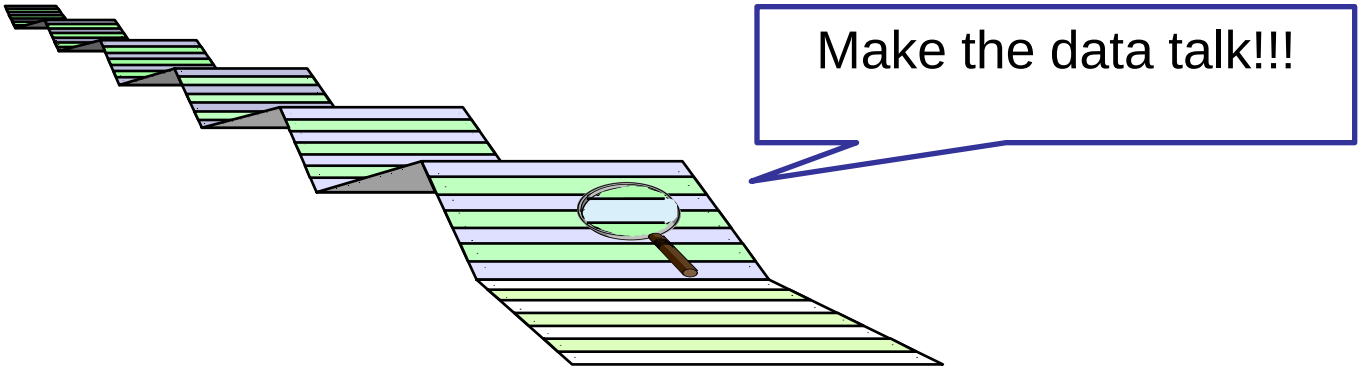
The First Four Steps

1. Collect and analyze information and data.
2. Talk with people familiar with the problem.
3. If at all possible, view the problem firsthand.
4. Confirm all findings.

The First Four Steps – Step 1

Step 1: *Collect and Analyze Information and Data*

Five to six weeks in the laboratory can save you an hour in the library.



The First Four Steps – Step 1

Collecting Information

- Google/Web Search
- Library Search
- Recall a Related Problem in a Class or Textbook
- Company or Other Reports (Old and New)
- Surveys
- Interviews

The First Four Steps – Step 1

Make the Data Talk

Set A		Set B		Set C		Set D	
X	Y	X	Y	X	Y	X	Y
10.0	8.04	10.0	9.14	10.0	7.46	8.0	6.58
8.0	6.95	8.0	8.14	8.0	6.77	8.0	5.76
13.0	7.58	13.0	8.74	13.0	12.74	8.0	7.71
9.0	8.81	9.0	8.77	9.0	7.11	8.0	8.84
11.0	8.33	11.0	9.26	11.0	7.81	8.0	8.47
14.0	9.96	14.0	8.10	14.0	8.84	8.0	7.04
6.0	7.24	6.0	6.13	6.0	6.08	8.0	5.25
4.0	4.26	4.0	3.10	4.0	5.39	19.0	12.50
12.0	10.84	12.0	9.113	12.0	8.15	8.0	5.56
7.0	4.82	7.0	7.26	7.0	6.42	8.0	7.91
5.0	5.68	5.0	4.74	5.0	5.73	8.0	6.89

Anscombe's Quartet Table

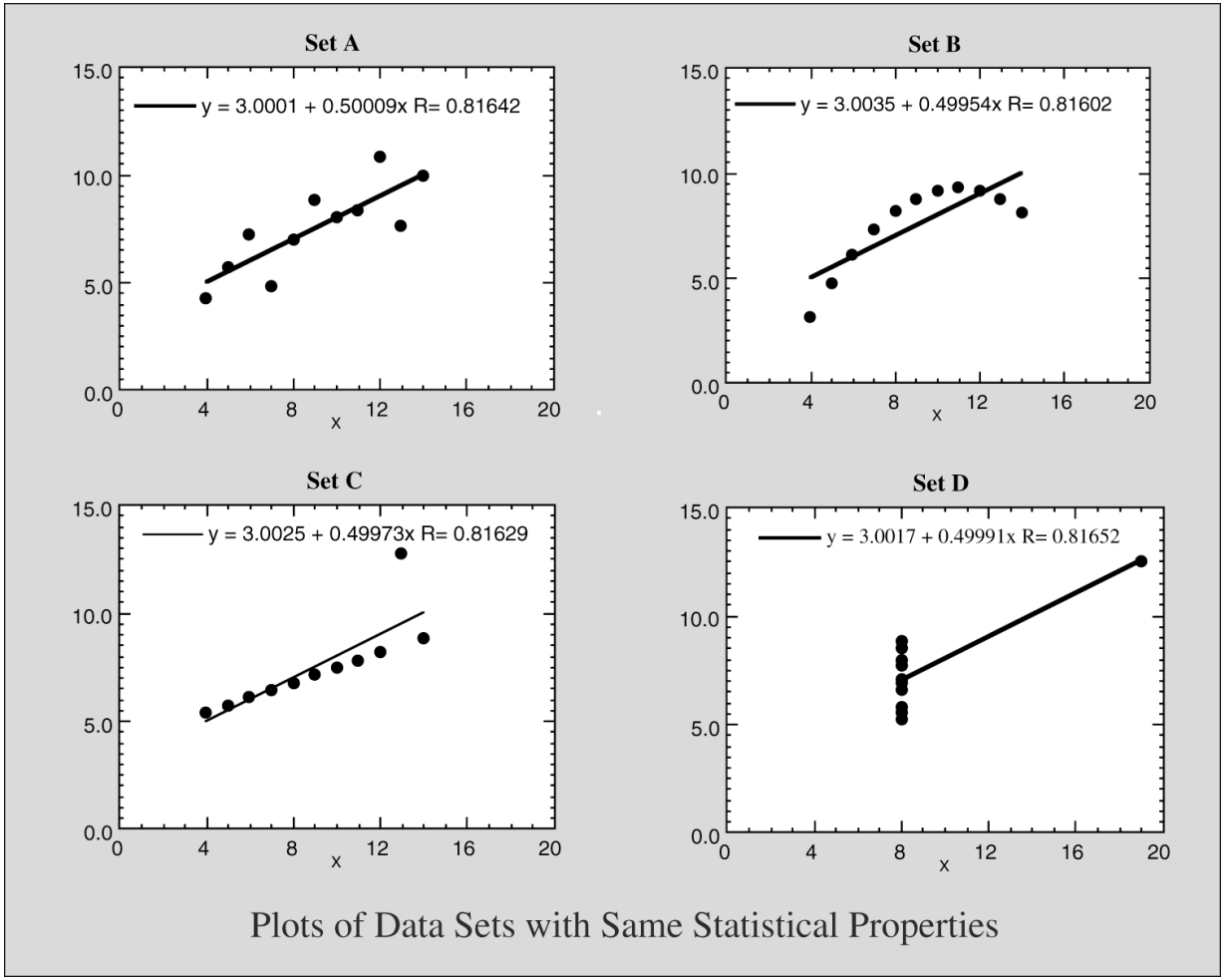
Each of these four data sets A, B, C, and D *all* have the following properties:

$N = 11$	Mean of X's = 9.0	Equation of regression line: $Y = 3 + 0.5\,X$
$t = 4.24$	Mean of Y's = 7.5	Standard error of estimate of slope = 0.118
$r^2 = 0.67$	Correlation coefficient = 0.82	Sum of squares $(X - \bar{X})^2 = 110.0$
Regression sum of squares = 27.50		Residual sum of squares of $Y = 13.75$

Statistically everything looks *the same!!*

The First Four Steps – Step 1

Make the Data Talk



Plots of Data Sets with Same Statistical Properties

The First Four Steps – Step 2

Step 2: *Talk with people familiar with the Problem*

- Find out who knows about the problem.

- Ask penetrating questions by using critical thinking and Socratic questioning. (Ch.3)

The First Four Steps – Step 2

Step 2: *Talk with people familiar with the Problem*

Find out who knows about the problem.

Ask penetrating questions by:

- Looking past the obvious
- Challenging the basic premise of proposed reason
- Asking for clarification when you do not understand something.

Use the 6 types of Socratic Questions

The First Four Steps – Step 2

Go Talk to George

Let's consider a situation in which, immediately upon replacement, a brand new flow meter begins to leak. List, in order, four people you would talk to.

The First Four Steps – Step 2

Let's consider a situation in which, immediately upon replacement, a brand new flowmeter begins to leak. List, in order, four people you would talk to.

1. **The person who installed the meter.**
2. **The technician who monitors the flowmeter.**
3. **The manufacturer's representative who sold you the flowmeter.**
4. **George.**

The First Four Steps – Step 2

Who's George?

- Every organization has a George. George is that individual who has years of experience to draw upon and also has street smarts.
- George is an excellent problem solver who always seems to approach the problem from a different viewpoint– one that hasn't been thought of by anyone else.
- Verbalizing the problem to individuals such as George can often provide a unique perspective on the situation.

Flow Meter Example

- Flow meters in a chemical plant were being corroded and would leak.
- Perceived problem: “Find materials to make meter from that will not corrode”.
- After much effort, no such materials were found.
- Real problem: “Keep the flow meter from leaking”.
- Solution: Regularly replace (cheap) flow meters.

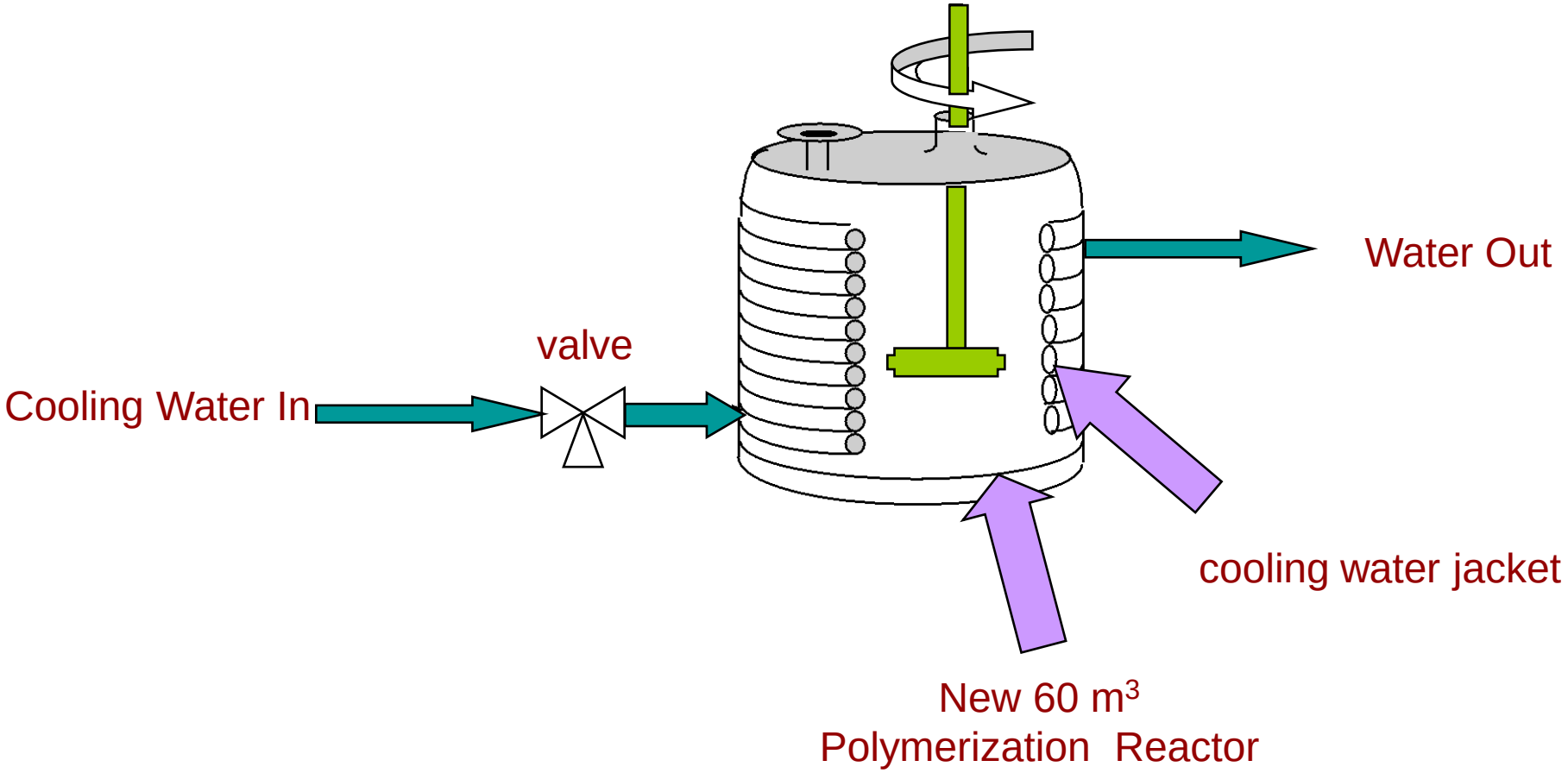
The First Four Steps – Step 3

Step 3: *View the Problem First Hand*

In the mid 1970s a company in the United Kingdom completed a plant to produce a plastic product (PVC). The main piece of equipment was a large reactor with a cooling jacket through which water passed to keep the reactor cool. When the plant was started up, the plastic was dark, nonuniform, and way off design specifications.

The First Four Steps – Step 3

Off-spec Polymer



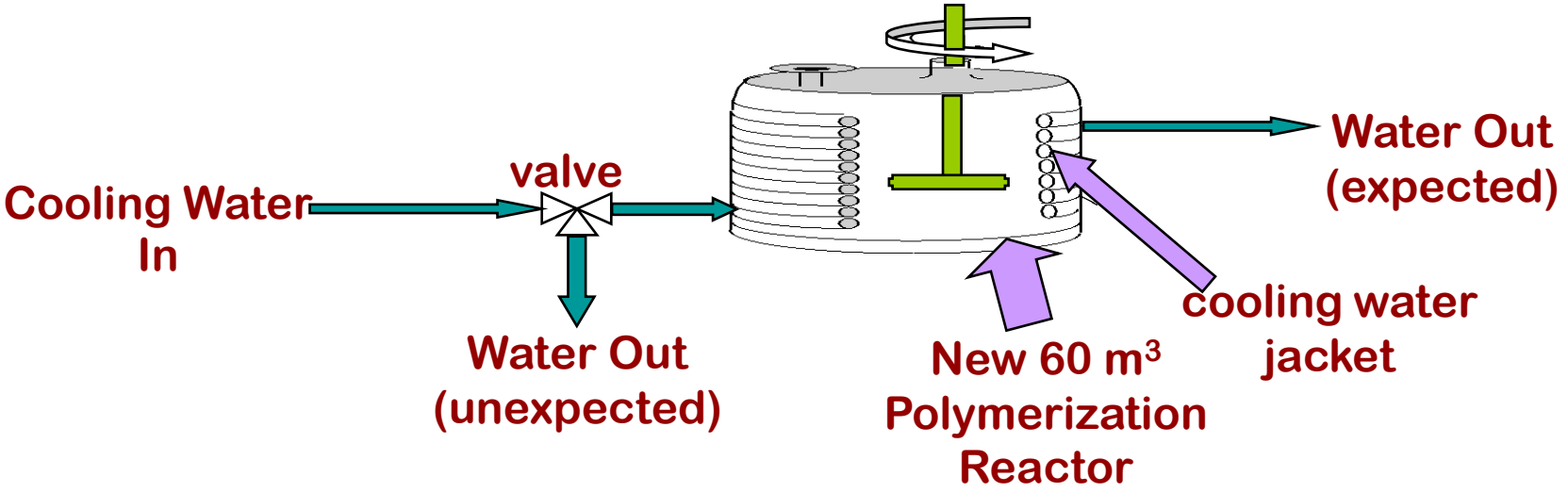
The First Four Steps – Step 3

What did they do?

- Reworked and refined their model and calculations
- Analyzed the procedure from every point of view on paper, and
- Had the raw material fed to the reactor analyzed.
- Unfortunately, nobody examined the reactor firsthand
- Finally after many days, one of the engineers decided to look into the reactor.

The First Four Steps – Step 3

However, they came up with the same results.



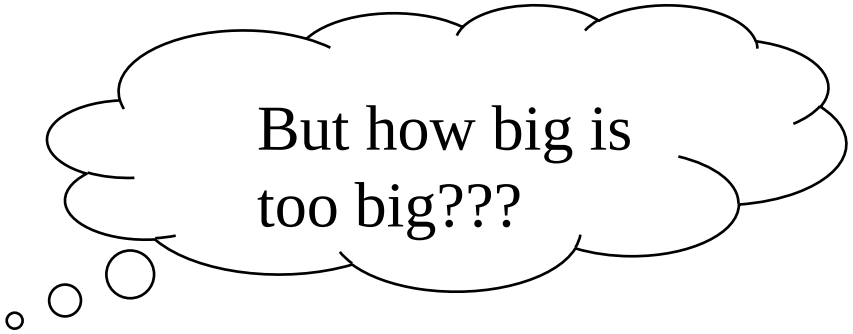
He found that a valve had been carelessly switched to the wrong position, thereby diverting cooling water away from the reactor so that virtually no cooling took place.

As a result the reactor overheated, producing a poor quality product. Once the valves were adjusted properly, the high quality plastic was produced.

The First Four Steps – Step 4

Step 4: *Confirm all Findings*

Remember to double check all findings



Example: Dead Fish

- Collecting data related to factory on river:
  - Fish kills below acceptable levels through July.
  - Fish kills above acceptable levels August 1, 15.
  - Toxins released on July 29 (but this level had not caused trouble before).
  - Water levels normal in July.
  - Water levels low in August.

Example: Exploding Cabinet

- Electrical company installed an electrical cabinet at a customer’s factory.
- The next day, the cabinet was energized, and exploded shortly after.
- The supervising engineer from the contractor went to inspect the site.
- He noticed that an unusual handle had been installed in the door of the cabinet.
- The factory maintenance staff had added the handle to allow access from their key.
- The handle had a metal rod protruding into the back.
- This metal rod caused a short circuit in the equipment.