Here's to the crazy ones,
the misfits, the rebels, the troublemakers, the round pegs in the square holes... the ones who see things differently —
they're not fond of rules...
You can quote them, disagree with them, glorify or vilify them, but the only thing you can't do is ignore them because
they change things...they push the human race forward,
and while some may see them as the crazy ones, we see genius, because the ones who are crazy enough to think that they can change the world,
they are the ones who do.

— Steve Jobs

Objectives
Discuss the learned skills that enable creative thinking
Describe the method for creative problem solving
Apply the methods of innovative problem solving to the laboratory environment

Three Zones of Functioning

Stable Zone
- No growth
- Stagnant
- Comfortable

Chaotic Zone
- Low productivity
- Constant crisis
- Haphazard

Creative Zone
- Creative tension
- Innovative
- In flux
Creativity vs. Innovation

Creativity: Coming up with new ideas
Innovation: Putting those ideas into practice

Lateral Techniques
Take a good idea and:
- substitute
- combine
- modify
- adapt
- magnify

Intuitive Techniques
- Relaxation
- Incubation
- Analogies
- Fantasy questions
- Visualization
- Dreaming
- Drawing

The Scientific Method
- Observation
  - Ask a question
  - Understand the background
- Hypothesis
  - State the likely cause
- Experimentation
  - Test the hypothesis
- Data Analysis
  - Collect data
  - Extract information and knowledge
- Conclusion
  - Communicate conclusions

The Innovation Method
- Background
  - Describe the outcome
  - What should have happened?
  - What actually happened?
- Discovery
  - Background
  - Describe the outcome
  - What should have happened?
  - What actually happened?
- Solutions
  - Find the likely cause
  - Challenge assumptions
- Analysis
  - Collect data
  - Extract information and knowledge
- Innovation
  - Communicate conclusions
  - Develop an action plan

**Describe the Outcome**

<table>
<thead>
<tr>
<th>Outcome</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>• A change to a</td>
<td>• A change to a situation</td>
</tr>
<tr>
<td>situation resulting</td>
<td>resulting from an action</td>
</tr>
<tr>
<td>• Often involves</td>
<td>• Often involves strong</td>
</tr>
<tr>
<td>strong emotions</td>
<td>emotions</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Output</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>• What is produced</td>
<td>• What is produced in a</td>
</tr>
<tr>
<td>in a given time</td>
<td>time period</td>
</tr>
<tr>
<td>period</td>
<td>• Mostly tangibles</td>
</tr>
</tbody>
</table>

**Listen to the Voices**

- Voice of the Customer
  - I had to be redrawn
- Voice of the Process
  - I do pretty well until I reach this one step
- Voice of Time
  - I've seen 4 similar errors this month
- Voice of the System
  - The downstream effect of this event destabilized the whole organization
- Voice of the Supplier
- Voice of the Output

**Describe the Outcome**

**STEP 1**

**Output**

- What is produced in a given time period
- Mostly tangibles

**Listen to the Voices**

- Voice of the Customer
  - I had to be redrawn
- Voice of the Process
  - I do pretty well until I reach this one step
- Voice of Time
  - I've seen 4 similar errors this month
- Voice of the System
  - The downstream effect of this event destabilized the whole organization
- Voice of the Supplier
- Voice of the Output

**STEP 2**

**What Should Have Happened?**

- SOP
- Process flow chart
- Manufacturer inserts
- Interviews

**Knowledgest Elication Questions**

<table>
<thead>
<tr>
<th>Goals</th>
<th>Actions</th>
<th>Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>What were you trying to</td>
<td>Did you know just what to do, or did you weigh several</td>
<td>Is this what you thought would happen?</td>
</tr>
<tr>
<td>do?</td>
<td>possible responses?</td>
<td></td>
</tr>
<tr>
<td>Were there conflicts,</td>
<td>What could you influence and what did you think you had</td>
<td></td>
</tr>
<tr>
<td>trade-offs, time pressure?</td>
<td>no control over?</td>
<td></td>
</tr>
</tbody>
</table>

**STEP 3**

**What Actually Happened?**

**Interview the players**

- Personnel involved
- Uninvolved staff members
- Supervisors and managers
- When possible, the customer

**Go Look, Go See**

**Background**

- What should have happened?
  - What actually happened?

**Discovery**

- Explain the facts
  - What actually happened?

**Solutions**

- Think critically
  - Convergent

**Analysis**

- Think critically
  - Analyze the evidence

**Innovation**

- Think creatively
  - Divergent
The “Five Whys”

Ask “Why?” in a non-judgmental manner until:

» you are discussing causes over which you have no control,
» you reach the point where the actions seem reasonable,
» you cannot know the answer, OR
» the answer is irrelevant to the event

STEP 4: IDENTIFY CAUSES
Active Failures vs. Latent Conditions

<table>
<thead>
<tr>
<th>Active Failures (Physical Actions)</th>
<th>Latent Conditions (System/Process Failures)</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Direct and immediate impact</td>
<td>• Part of the system's design</td>
</tr>
<tr>
<td>• Committed by the people who do the job</td>
<td>• Created by organizational management</td>
</tr>
<tr>
<td>• Rarely “Root Causes”</td>
<td></td>
</tr>
</tbody>
</table>

10% 90%

STEP 4: IDENTIFY CAUSES
Understanding and correcting latent conditions ensures unexpected events do not recur.

• Active failures are the result of actions that seemed reasonable at the time
• Inaccurate perception of what is reasonable comes from latent conditions
• Use active failures to chase down latent conditions.

STEP 4: IDENTIFY CAUSES
Identify Any Contributing Factors

• Institutional
• Organization or Managerial
• Environmental
• Team Dynamics
• Individual
• Task-related
• Customer-related

Examples:

Regulations are counterintuitive and difficult to apply.
Due to global economic pressures, stress is high, resources are low.
Regulations for each state are different and difficult to remember.

Contributing Factors

Factor  Institution

Influence  Economics
National healthcare climate
State regulators and regulations

Contributing Factors

Factor  Organization and Management

Influence  Finances
Organizational structure
Policy standards and goals
Safety culture and priorities

Examples:

SOP’s are counterintuitive and difficult to apply.
Due to organizational economic pressures, stress is high, resources are low.
Unspoken pressure to work faster; public commitment to accuracy
### Contributing Factors

#### Factor: Work Environment

**Influence:**
- Staffing, skills mix
- Workload, shift patterns
- Equipment
- Physical plant conditions

#### Example:
- Subtle arrogance of long-term staff members.
- Workload is not matched to staffing levels.
- Equipment is old and requires constant repair and monitoring.
- Construction is noisy and ongoing.

### Contributing Factors

#### Factor: Team

**Influence:**
- Communication—written and verbal
- Supervision and support
- Team structure

#### Example:
- Team is culturally and racially mixed.
- Supervisor is rarely on-site.
- Staff are expected to make decisions above their level of authority.
- Staff are rarely involved in or told of decisions that affect them.

### Contributing Factors

#### Factor: Individual

**Influence:**
- Knowledge and skills
- Competence
- Physical and mental health condition

#### Example:
- Attentional resource was not focused on the task.
- Skill level is low.
- Employee training was deficient.
- Employee failed to judge the situation accurately.

### Contributing Factors

#### Factor: Task

**Influence:**
- Design and clarity
- Protocol accessibility
- Test result accuracy and accessibility

#### Example:
- Physician was verbally abusive to the employee.
- There was a language barrier between the employee and the patient.
- Employee was not aware of the historical events leading to the encounter.

### Contributing Factors

#### Factor: Patient/Customer

**Influence:**
- Complexity and seriousness of condition
- Communication barriers
- Personality and social issues

### Rules of Causation #1

**Root cause statements must clearly show a “cause and effect” relationship.**

- **Instead of:**
  - “The technologist was tired so she verified the wrong result.”
- **Instead of:**
  - “The technologist was fatigued from working overtime, which increased the likelihood that she overlooked a step, which in turn caused the reporting of an incorrect result.”
Rules of Causation #2

Negative descriptions should not be used in root cause statements.

» Instead of:
  * "The employees on this shift are lazy."

» Employees are expected to process between 10 and 15 samples per hour; during this period, the average number a samples processed for all employees on the shift was 7.5 samples per hour.

Rules of Causation #3

Each human error must have a preceding cause.

» Instead of:
  * "The cause of this failure was human error."

» The employee entered the wrong number
  • Why? She was transcribing the results from a worklist and got off line
  • Why? The patient name is on the left side of the page and the result on the right side
  • Why? The page has been adapted from another procedure, instead of designed for this one

Rules of Causation #4

Violations of procedure are not root causes; they must have a preceding cause.

» Instead of:
  * "This employee never follows procedures."

» "The procedure is complex and the documentation difficult to follow; thus, employees often develop work-around practices."

Rules of Causation #5

Failure to act is only causal when there is a pre-existing duty to act.

» Instead of:
  * "Everyone knows that client concerns should be passed on to the supervisor, but this was not done."

» "The employee did not notify the supervisor that the client had questioned the result. The procedure and the job description do not include this as a required step."

Rules of Causation #6

Solutions that have not yet been implemented are not causes.

» Instead of:
  * There was no script available, so the employee misinformed the client."

» "There is a great deal of information required when calls like this are received and the employee failed to mention one of the more important pieces of information. We will consider scripting for scenarios such as this one."

People → Process → Value that is Marketable → Culture → Behavior that is Sustainable → Work Designed to Human
Human Error

You don’t get to safe systems that have human beings in them by yelling at them or asking them to try harder.

— Donald Berwick

Sensory input enters your memory system

Sensory Memory (SM) codes or recodes the information. SM decays in a second or less unless refreshed or stored.

Paying attention moves information from SM to STM.

Stored information goes into Short-term Memory (STM). STM memory is overwritten in about 15 seconds unless rehearsed.

Important and rehearsed information goes into Long-term Memory (LTM).

Information is stored in LTM forever, although it may not be packaged in the same way.

Forgetting Curve

Lost

Retained

Sequestered

Drawing/Playing

Seeing

Hearing/Listening

First Exposure

Time

Retalled

Teaching

Process Design

Every system is perfectly designed to achieve exactly the results it gets.

— Paul Baralden

ERROR SOURCE

ERROR RESPONSE

VIOLATION

(complexity, weight)

MISTAKE

(judgment, capability)

LATENT

(memory, attention)

SLIP

(motility, skill)

Separate the employee from the risk of causing harm.

Evaluate team dynamics, leadership.

Consider if employee was between a rock and a hard spot.

Rule-based: Coach, role play

Knowledge-based: Train or retrain.

Eliminate redundant steps in the SOP (save time, etc).

Consider automation, error proofing.

Develop job aids, memory aids, checklists.

Reduce distractions, interruptions.

Reduce task complexity, simplify the task.

Explore environmental conditions (noise, heat, etc).

Consider if employee was between a rock and a hard spot.

Facilitate team dynamics, leadership.

Explore team dynamics, leadership.

Consider Simplification as a Factor.

Rule-based: Coach, role play

Knowledge-based: Train or retrain.

Eliminate redundant steps in the SOP (save time, etc).

Consider automation, error proofing.

Develop job aids, memory aids, checklists.

Reduce distractions, interruptions.

Reduce task complexity, simplify the task.

Explore environmental conditions (noise, heat, etc).

Consider if employee was between a rock and a hard spot.

Facilitate team dynamics, leadership.

Explore team dynamics, leadership.

Consider Simplification as a Factor.

Rule-based: Coach, role play

Knowledge-based: Train or retrain.

Eliminate redundant steps in the SOP (save time, etc).

Consider automation, error proofing.

Develop job aids, memory aids, checklists.

Reduce distractions, interruptions.

Reduce task complexity, simplify the task.

Explore environmental conditions (noise, heat, etc).

Consider if employee was between a rock and a hard spot.

Facilitate team dynamics, leadership.

Explore team dynamics, leadership.

Consider Simplification as a Factor.
Culture

If we are to preserve culture we must continue to create it.

— Johan Huizinga

Challenge Assumptions

"Your assumptions are your windows on the world. Scrub them off every once in a while, or the light won't come in."

— Isaac Asimov

Lateral Thinking

Making the simple complicated is commonplace; making the complex simple, awesomely simple, that's creativity.

— Charles Mingus

Lateral thinking techniques

- Generating Alternatives
- Suspending Judgment
- Fractionating
- Reversing
- Brainstorming and Stimulating
- Focusing and Polarizing
- Finding Connections
Imaginative Thinking

The intuitive mind is a sacred gift and the rational mind is a faithful servant. We have created a society that honors the servant and has forgotten the gift.

— Albert Einstein

Intuitive techniques

- Observing
- Analogizing
- Pattern Matching
- Imagining
- Abstracting
- Chunking
- Body Thinking, Empathizing
- Modeling, Playing
- Transforming
- Synthesizing

Define the Ideal Future State

Consider All Points of View
Uncover Failure Potential

Assign Responsibility

Blocks to Innovation

Break the Rules

- Pursuit of Order
- Fear of Failure
- Winning at all Cost
- Failure to Incubate
- Judging Instead of Generating

- Pre-empt Your Competition
- Use All Available Assets
- Redefine Winning
- Cooperate and Collaborate
Summary

1. Know what you know; know what you don't know
2. Determine causes and challenge assumptions
3. **Think creatively, then think critically**
4. Innovate
5. Act