HOW to CREATE
a GOOD
GRADING RUBRIC

Tom Penird
Washtenaw Community College
Topics for Discussion

- What is a rubric?
- Types of rubrics
- When to create a rubric?
- Who should create a rubric?
- The scoring guide and different formats
- Involving students in the process
- Evaluation of a rubric
- What to do with the data?
- Examples
What is a Rubric?

• A scoring tool that lists what is important and identifies the difference between excellent and poor work

• A tool used to score a behavior or an item
  – Behavior (competency or performance)
  – Item (essay, art assignment or portfolio)
Types of Rubrics

• Holistic: Global view of the task or assignment

• Analytic: Looks at key characteristics from the task or assignment
When to Create a Rubric?

• Should always be created ahead of time
• Identify:
  – What you are assessing
  – The levels of performance
• The actual assessment should be tied to:
  – The lesson plan objective
  – An outcome for the class/program
Who Should Create a Rubric?

• Who?
  – Faculty
  – Advisory committee
  – Students

• If possible more than one person should be involved in:
  – Establishing the criteria for assessment
  – Identifying the scoring process
  – Creating the scoring guide
Different Formats Used for Scoring

Examples for ranking systems
- Meets objective, Lacking parts of objective, Fails to meet objectives
- Poor, Good, Excellent
- Pass, Fail
- Delicious, Good, Need Improvement, Poor
The Scoring Guide

• A scoring guide clearly defines the difference between the levels of score. What is excellent, good, poor, or a 5 vs. 1, or passing vs. failing?

• The rubric should have a scoring guide built within, or included, to provide a clear understanding of how each item will be assessed.

• Remember it may be months before you use the rubric. There should be no questions to what each of the criteria are.
Involving Students in the Process

- When students use the rubric to judge their own work, they take on responsibility.
- Share the rubric with the students upfront—this helps define good and bad work.
- Do the students understand the assignment and the criteria described in the rubric?
- Do the students have good examples for each of the characteristics you will be measuring?
  - Describe the “best work”
  - Describe “work that is lacking”
  - Describe “failing work”
Evaluation of a Rubric

• Make a mock trial run

• Have another faculty member use to grade sample tasks/assignments
What to Do With the Data?

• The data should be reflective of:
  – The objective for the lesson plan
  – An outcome for the course
  – An outcome for the program

• Capture the data and review the data with:
  – Department members
  – Advisors
  – Students
Examples
EXAMPLE RUBRIC

Chocolate Chip Cookie
Chocolate chip cookie rubric

The cookie elements the students chose to judge were:

- Number of chocolate chips
- Texture
- Color
- Taste
- Richness (flavor)

4 - Delicious:

Chocolate chip in every bite
Chewy
Golden brown
Home-baked taste
Rich, creamy, high-fat flavor
3 - Good:

Chocolate chips in about 75 percent of the bites taken
Chewy in the middle, but crispy on the edges
Either brown from overcooking, or light from being 25 percent raw
Quality store-bought taste Medium fat content

2 - Needs Improvement:

Chocolate chips in 50 percent of the bites taken
Texture is either crispy/crunchy from overcooking or doesn't hold together because it is at least 50 percent uncooked
Either dark brown from overcooking or light from undercooking
Tasteless
Low-fat content

1 - Poor:

Too few or too many chocolate chips
Texture resembles a dog biscuit
Burned
Store-bought flavor with a preservative aftertaste – stale, hard, chalky Non-fat contents
# Chocolate Chip Cookie Rubric

Here's how the table looks:

<table>
<thead>
<tr>
<th></th>
<th>Delicious</th>
<th>Good</th>
<th>Needs Improvement</th>
<th>Poor</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Number of Chips</strong></td>
<td>Chocolate chip in every bite</td>
<td>Chips in about 75% of bites</td>
<td>Chocolate in 50% of bites</td>
<td>Too few or too many chips</td>
</tr>
<tr>
<td><strong>Texture</strong></td>
<td>Chewy</td>
<td>Chewy in middle, crisp on edges</td>
<td>Texture either crispy/crunchy or 50% uncooked</td>
<td>Texture resembles a dog biscuit</td>
</tr>
<tr>
<td><strong>Color</strong></td>
<td>Golden brown</td>
<td>Either light from overcooking or light from being 25% raw</td>
<td>Either dark brown from overcooking or light from undercooking</td>
<td>Burned</td>
</tr>
<tr>
<td><strong>Taste</strong></td>
<td>Home-baked taste</td>
<td>Quality store-bought taste</td>
<td>Tasteless</td>
<td>Store-bought flavor, preservative aftertaste – stale, hard, chalky</td>
</tr>
<tr>
<td><strong>Richness</strong></td>
<td>Rich, creamy, high-fat flavor</td>
<td>Medium fat contents</td>
<td>Low-fat contents</td>
<td>Nonfat contents</td>
</tr>
</tbody>
</table>
Looking at the Larger Picture

Example

– How do we link the data to the course?
– Where is the data from the rubric entered?
– How are the rubrics used to aid in changes needed in a course or a program?
Course Assessment

- **Master Syllabus – Assessment Plan**

- Collect Data
  - Administer tool
  - Score
  - Display Data

- Analyze Data
  - Quantitative
  - Qualitative

- Report Results
  - Degree to which students are learning
  - Strengths and weaknesses
  - Changes to be made

- Implement recommendations
This course develops proficiency in setup and operation of CNC Machining and Turning Centers. Students master CNC machine tool controls through laboratory experiences and the manufacturing of pre-programmed parts. Part holding techniques and alignments are included in the course material. Process planning, tooling for CNC Machine Tools and inspection of machined products are also part of the course.
Introduction to Computerized Machining (CNC)

OUTCOMES
- Students will be able to setup and operate Vertical Machining Centers and Turning Centers.
- Students will set machine parameters for machine tool operations at multiple work locations.
- Students will analyze part measurements and derive necessary changes at the machine tool registers to produce parts within specified tolerances.

ASSESSMENT
- Department Proficiency Exams (Rubric)
- Capstone Projects (Rubric)
- Capstone Projects (Rubric)
  Department Exams (Problem solving, Matching, Short answer)
MACHINE SET UP
Use the parallels provided at the machine to locate part elevation within the machine tool.

1. X-Y ZERO **G54 (Right Vise)**
   X-Y zero is located at the center of the 1.00” diameter hole at the center of the block.

2. X-Y ZERO **G55 (Right Vise)**
   X-Y zero is located at the front left corner of the 4.00” square block with the hole

3. Z - ZERO
   Z - zero is located .5” above the top of both parts
   All tools are be to set to the G54 part
   The appropriate Z value for the tool to work at G56 is to be recorded at the sheet below

4. TOOLING LIST SUMMARY
   Tool 2 = 3/4” - Ball nose end mill (Programmed point is the center of the ball)
   Tool 3 = 1/4” - HSS Drill (Programmed point is the full body diameter)
   Tool 5 = 3/4” - 2 - flute end mill (Programmed point is the end)
# NCT 112 Assessment Component

Application of key concepts related to CNC machining control units. Key concepts are to include: work offsets, tool length offsets, tool geometry offsets, cutter diameter compensation, tool wear offsets, and multiple fixture offsets.

## Rubric

<table>
<thead>
<tr>
<th>Objective</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Is not able to perform task or did not attempt this task</td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Performance of task incorrectly. Value(s) obtained at the controller incorrect</td>
<td></td>
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</tr>
<tr>
<td>Value(s) obtained at controller not properly located in the machine controller</td>
<td></td>
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<tr>
<td>Just outside acceptable limit. Value(s) obtained at the controller within the accepted tolerance.</td>
<td></td>
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</tr>
</tbody>
</table>

- Establish work offset at center of a round feature using a dial test indicator.
- Load tool – holder into proper carousel location.
- Align a fixture to the x axis of a machining center to within .0005” over 4” length.
- Establish appropriate tool length offset at the full body diameter of a 118° drill, given the Z-zero plane and the drill diameter.
- Establish appropriate tool length offset at the center of a ball nose end mill, given the Z-zero plane and the diameter of the ball nose end mill.
- Set multiple work offsets, given a...
**“Refined” SCORING GUIDE**

**BETTER SCORING GUIDE**

**NCT 112 ASSESSMENT COMPONENT RUBRIC**

Application of key concepts related to CNC machining control units. Key concepts are to include, work offsets, tool length offsets, tool geometry offsets, cutter diameter compensation, tool wear offsets, and multiple fixture offsets.

<table>
<thead>
<tr>
<th>OBJECTIVE</th>
<th>1 See Below</th>
<th>2 See Below</th>
<th>3 See Below</th>
<th>4 See Below</th>
<th>5 See Below</th>
</tr>
</thead>
<tbody>
<tr>
<td>Align a fixture to the x axis of a machining center to within .0005” over 4” length</td>
<td>Aligned to within .005</td>
<td>Aligned to within .003</td>
<td>Aligned to within .002</td>
<td>Aligned to within .001</td>
<td>Aligned to within .0005</td>
</tr>
<tr>
<td>Establish work offset at center of a round feature using a dial test indicator</td>
<td>Did not attempt</td>
<td>X and Y axis outside ± .020 from actual value</td>
<td>X within .005 Y axis outside .020 from actual value</td>
<td>X and Y axis within ± .005 of actual value</td>
<td>X and Y axis within ± .0025 of actual value</td>
</tr>
<tr>
<td>Set multiple work offsets, given a jump-edge-finder and part locations.</td>
<td>Did not attempt</td>
<td>X and Y axis outside ± .020 from actual value</td>
<td>X within .005 Y axis outside .020 from actual value</td>
<td>X and Y axis within ± .005 of actual value</td>
<td>X and Y axis within ± .0025 of actual value</td>
</tr>
<tr>
<td>Established correct Z-Work Offset for multiple work offsets</td>
<td>Did not attempt</td>
<td>Z value outside ± .020 from actual value</td>
<td>Z Value within ± .020 of actual value</td>
<td>Z Value within ± .010 of actual value</td>
<td>Z Value within ± .005 of actual value</td>
</tr>
<tr>
<td>Load tool – holder into proper carousel location</td>
<td>Did not attempt</td>
<td>No Tools loaded correctly</td>
<td>One tool loaded correctly</td>
<td>Two tools loaded correctly</td>
<td>Three tools loaded correctly</td>
</tr>
<tr>
<td>Establish appropriate tool length offset at the center of a ball nose end mill, given the Z-zero plane and the diameter of the ball nose end mill.</td>
<td>Did not attempt</td>
<td>The tool length offset was not within one tool radius value</td>
<td>The radius of the tool was subtracted or added incorrectly</td>
<td>Tool Length Offset is correct within ± .020</td>
<td>Tool Length Offset is correct within ± .005</td>
</tr>
<tr>
<td>Establish appropriate tool length offset at the full body diameter of a 118°drill, given the Z-zero plane and the drill diameter</td>
<td>Did not attempt</td>
<td>The tool length offset was not within one tip length value</td>
<td>The tip of the tool was subtracted or added incorrectly</td>
<td>Tool Length Offset is correct within ± .020</td>
<td>Tool Length Offset is correct within ± .005</td>
</tr>
<tr>
<td>Establish appropriate tool length offset at the tip of an end mill, given the Z-zero plane and the drill</td>
<td>Did not attempt</td>
<td>Tool Length Offset was attempted and is</td>
<td>Tool Length Offset is correct within ± .020</td>
<td>Tool Length Offset is correct within ± .010</td>
<td>Tool Length Offset is correct within ± .005</td>
</tr>
<tr>
<td>Item to check</td>
<td>YES</td>
<td>No</td>
<td>Points</td>
<td></td>
<td></td>
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<tr>
<td>--------------------------------------------</td>
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<tr>
<td><strong>VISE ALIGNED</strong></td>
<td></td>
<td></td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Left Vise</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Value off If No</td>
<td></td>
<td></td>
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<td></td>
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<tr>
<td><strong>WORK OFFSET</strong></td>
<td></td>
<td></td>
<td>5</td>
<td></td>
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</tr>
<tr>
<td>G54 HOLE CENTER “X” VALUE 2.2931</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>G54 HOLE CENTER “Y” VALUE 7.3928</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>G55 X VALUE 3.9960</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>G55 Y VALUE 8.8890</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>G56 Z only AT TOP SURFACE OF PART VALUE + OR - VALUE 1.3969</td>
<td>1</td>
<td></td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>LOCATION</strong></td>
<td></td>
<td></td>
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<td></td>
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</tr>
<tr>
<td>Tool 2 = ⅜&quot; - Ball Nose Turret location # 2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tool 3 = ¼&quot; – HSS Drill Turret location # 3</td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Tool 5 = ⅜&quot; – 4 flute endmill Turret location #5</td>
<td></td>
<td></td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>TOOL LENGTH OFFSET</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tool 2 = ⅜&quot; - Ball Nose CENTER 12.0599</td>
<td>7</td>
<td></td>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tool 3 = ¼&quot; – HSS Drill FULL BODY 8.6389</td>
<td>7</td>
<td></td>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tool 5 = ⅜&quot; – 4 flute endmill END 11.1290</td>
<td>7</td>
<td></td>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>GRADE RUBRIC LATHE (10 minutes) 12 minutes</strong></td>
<td></td>
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<tr>
<td>- 3pts 15 minutes – 6pts</td>
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</tr>
<tr>
<td><strong>Item to check</strong></td>
<td></td>
<td></td>
<td>50</td>
<td></td>
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<tr>
<td>Turning Facing Tool</td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>X -8.6130</td>
<td>1</td>
<td>1</td>
<td>6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Z -17.2550</td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Drill</td>
<td></td>
<td></td>
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<td></td>
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</tr>
<tr>
<td>X -15.4254</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Z -12.3640</td>
<td></td>
<td></td>
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<td></td>
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</tr>
<tr>
<td><strong>TOTALS</strong></td>
<td></td>
<td></td>
<td>50</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
DATA
and
ANALYSIS

Hands On

AVERTAGES

Written test – problem solving “Critical Thinking”

<table>
<thead>
<tr>
<th>OBJECTIVE</th>
<th>1</th>
<th>2</th>
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<tr>
<td>Is not able to perform task or did not attempt this task</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Performance of task incorrectly. Value(s) obtained at the controller incorrect</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tool geometries at the lathe incorrect for the X and Z axis due to part length additions</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Align a fixture to the X axis of a machining center to within 0.005&quot; over 4&quot; length</td>
<td>5.8</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Establish work offset at center of a round feature using a dial test indicator.</td>
<td>4.84</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Set multiple work offsets, given a jump-edge-finder and part locations.</td>
<td>4.17</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Established correct Z-Work Offset for multiple work offsets</td>
<td>5.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Load tool – holder into proper carousel location</td>
<td>4.05</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Establish appropriate tool length offset at the center of a ball nose end mill, given the Z-zero plane and the diameter of the ball nose end mill.</td>
<td>4.69</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Establish appropriate tool length offset at the full body diameter of a 1&quot; drill, given the Z-zero plane and the drill diameter.</td>
<td>4.17</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Establish appropriate tool length offset at the tip of an end mill, given the Z-zero plane and the drill diameter.</td>
<td>5.73</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Set tool geometry and tip type for a center cutting tool at a turning center.</td>
<td>3.97</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Set tool geometry and tip type for a turning facing tool at a turning center.</td>
<td>3.19</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Establish appropriate tool wear offset at the register of a machining center given specific post-part conditions</td>
<td>3.19</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Establish an appropriate CDC value at the appropriate register of the machining center given specific post-part conditions</td>
<td>3.17</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Establish an appropriate change in work offset values at the register of the machining center given specific post-part conditions</td>
<td>2.73</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Establish an appropriate wear offset at the register of the turning center given specific post-part conditions</td>
<td>3.55</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Observations

• Few fours (4) scored in hands on portion.
• Clear picture between students scoring average score of 4+ and 4- on the hands on portion.
• On the written portion of the test the distribution curve is bell shaped.
• Students fair best on tool length problem solving.
• Students faired worse on multiple work offset problem solving.
Course Assessment Report

Background Information

I. Course assessed:
   Course Discipline Code and Number: NCT 112
   Course Title: Introduction to Computer Numerical Control
   Division Code: HAT   Department Code: INTD

II. Semester assessment was administered (check one):
   ☑ Fall 2005
   ☐ Winter 20
   ☐ Spring/Summer 20

III. Assessment tool used (check one):
   Please attach a copy of the tool and scoring rubric used.
   ☐ Portfolio
   ☐ Standardized test
   ☐ Other external certification/licensure exam (please describe):
   ☐ Survey
   ☐ Prompt
   ☑ Departmental exam
   ☑ Capstone experience (please describe): Manufactured Parts at CNC Machines
   ☐ Other (please describe):

   Has this tool been used before?
   ☐ Yes
   ☑ No

   If yes, has this tool been altered since its last administration? If so, briefly describe changes made.
   No...But altered descriptors to better identify a score of 1 vs. 5 at each objective

IV. Please list the section(s) in which this tool was administered:
   NCT 112 01

V. How many students were assessed? All completing the class
Assessment Results

Results

I. Briefly describe assessment results based on data collected for the course assessed, demonstrating to what extent students are achieving the learning outcomes as found in the master syllabus (see attached).

Please attach any data collected.

Outcome: Students will be able to setup and operate Vertical Machining Centers and Turning Centers.
Success: 75% of the student population having an average score of 3 or greater on the rubric for the final proficiency
Actual 100% of the students average 4.01 or 80% on the Final

Outcome: Students will set machine parameters for machine tool operations at multiple work locations.
Success: 100% of the projects reviewed have an average score of 3 or greater on the rubric.
The average score for the projects for all students completing the class was 3.96

Outcome: Students will analyze part measurements and derive necessary changes at the machine tool registers to produce parts within specified tolerances.
Success: 75% of students resolve more than 50% of the changes needed to “fix the part(s)” at problem solving component(s) to the final exam
75% of students resolved more than 30% of the changes needed to “fix the problem” at the problem solving component(s) to the final.

Looking at the distribution for the class I am pleased with this data. The success number, at the master syllabi will be changed to reflect this new number.
II. Based on the outcomes outlined in the master syllabus for the course assessed, did students meet expectations of the learning outcomes of that course?
   X Yes
   X No

Note: Expectation for success at mastersyllabi for outcome #3 too high based on grading criteria. Expectations for students is acceptable

Percentage of students meeting outcomes: __________ %

III. What areas of strength and weakness in students' achievement of the learning outcomes of the assessed course (as stated in the master syllabus) did assessment results show?

   Strengths: The hands on components of the course. (Setup)
              Producing good parts

   Weaknesses: Lathe setup
Action Plans

Changes influenced by assessment results

I. If weaknesses were found (see III above) or students did not meet expectations, what action will be taken to address this?

   Weakness is due to lack of machine tools. We currently only have one CNC turning center while we have 3 CNC milling centers. A request for Perkins funds has been made to purchase another CNC turning center.

II. Identify any other intended changes that will be instituted based on results of this assessment activity (check all that apply). Please describe changes and give rationale for change.

   □ Master syllabus
   Description and rationale: ____________
   The definition of success at the master syllabus for outcome #3 will be altered to reflect the scoring system used this semester. 75% of students resolved more than 30% of the changes needed to “fix the problem” at the problem solving component(s) to the final.
Reference

The chocolate chip cookie:

http://www.teachervision.fen.com/teaching-methods-and-management/rubrics/4522.html#what_is_a_rubric