2.6 Creativity II

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Preview

- In the previous sequence, *creativity* was defined and *creative skills* were outlined.

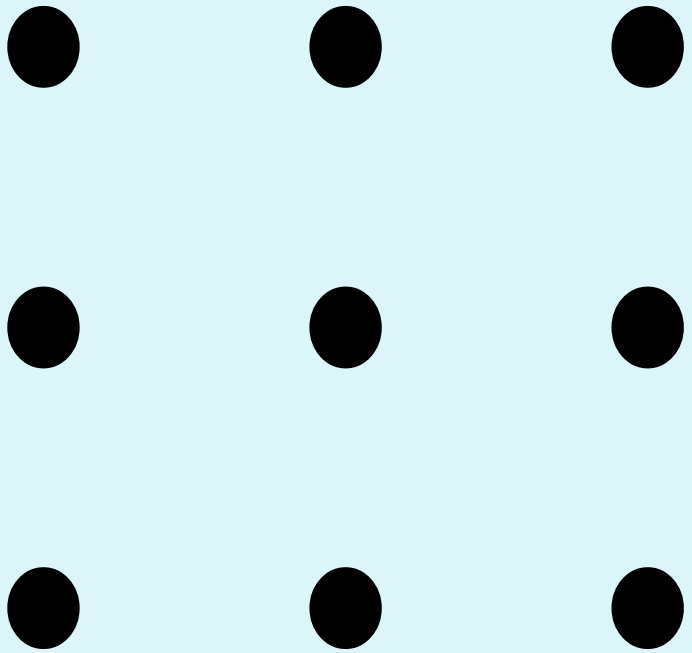
- In this sequence, four problems will be provided and creative thinking will be used to solve them.

- The following four problems can be found in the book:

- **Foundations of Engineering** by Holtzapple and Reece. McGraw Hill. 2nd edition 2003.

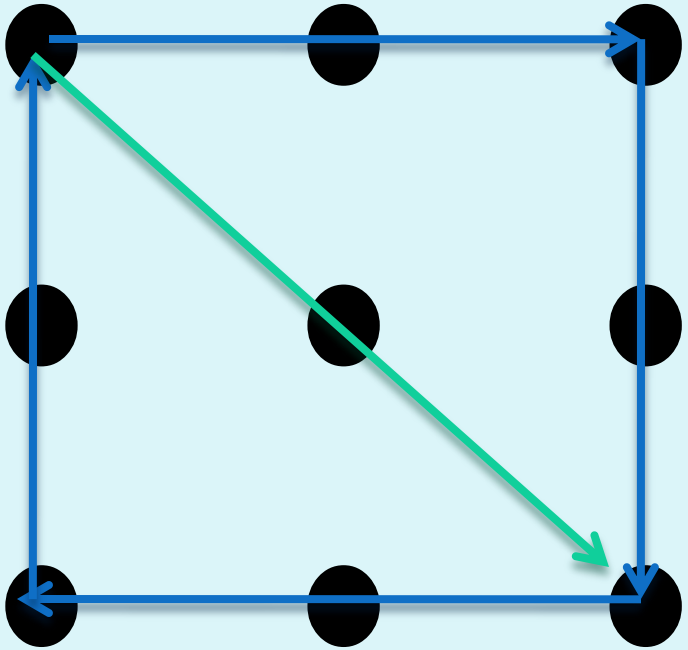
Problem 1

- Connect the nine dots with four contiguous lines.



The first try does not work!

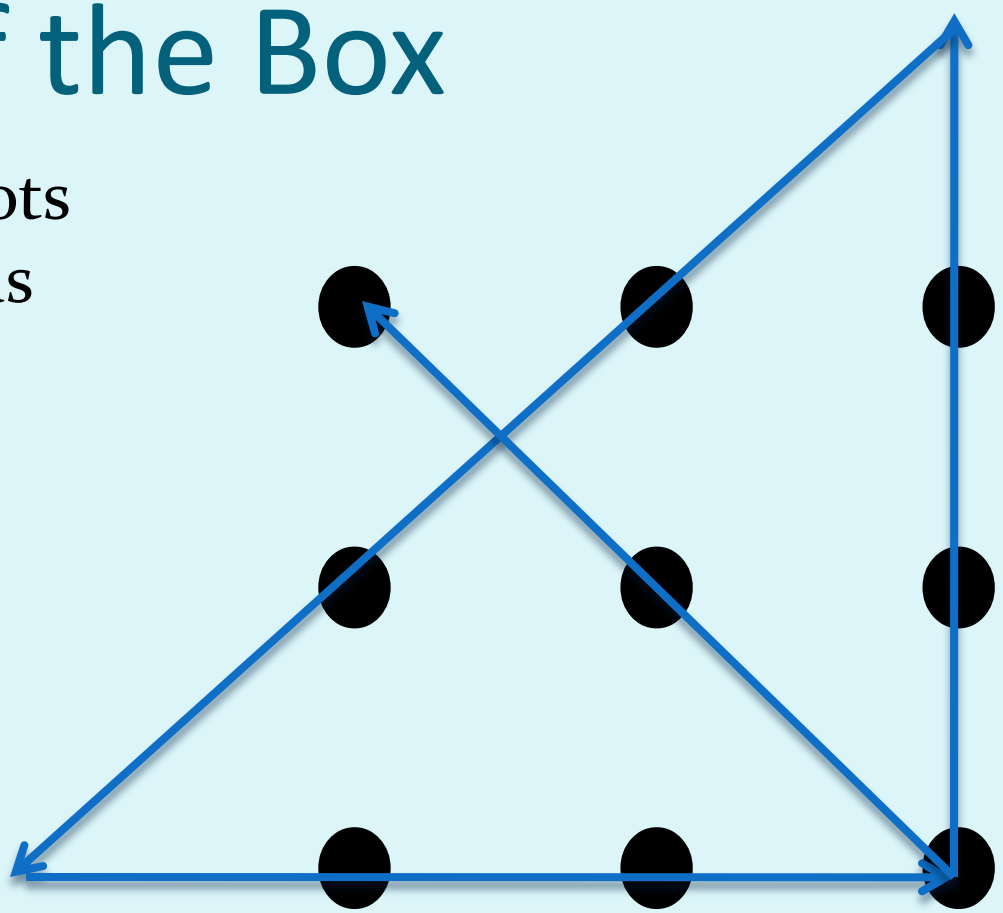
- Connect the nine dots with four contiguous lines.



- Now, if we can use 5 lines!

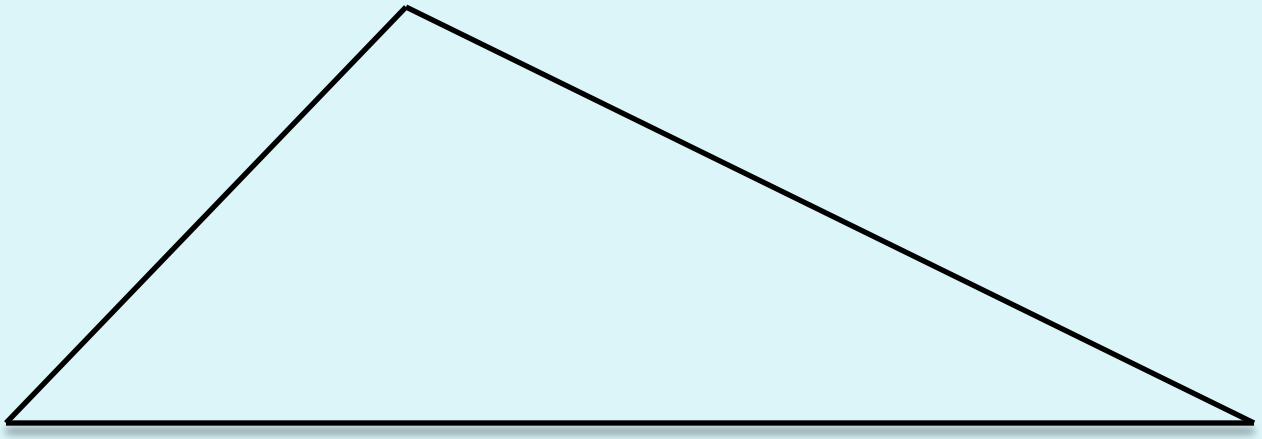
Think Out of the Box

- Connect the nine dots with four contiguous lines.



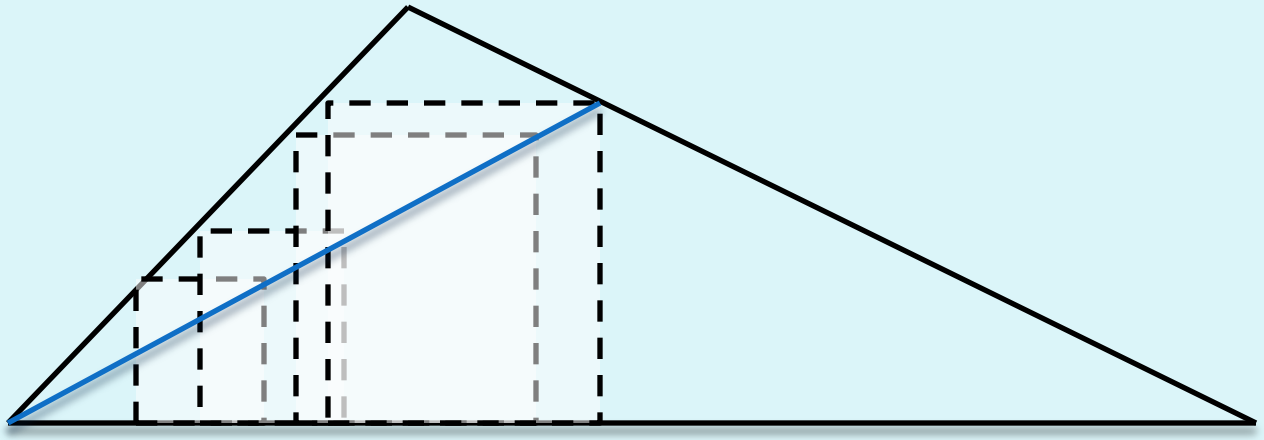
Problem 2

- Inscribe a square in any given triangle. Two vertices should be on be on the triangle base, the other two on the triangle base.



Relax the constraints

- Let only three vertices touch the triangle.
- Increase the square size by steps



Problem 3

- Given that p, q, and r are real positive numbers, prove that

$$\frac{(p^2+1)(q^2+1)(r^2+1)}{pqr} \geq 8$$

- Three unknowns and only one equation. How to solve?
- Try to find a contradiction. No luck!

See a pattern and simplify

$$\frac{\left(p^2+1\right)\left(q^2+1\right)\left(r^2+1\right)}{pqr} \geq 8$$

Note that the three parameters: *p*, *q*, and *r* have same format

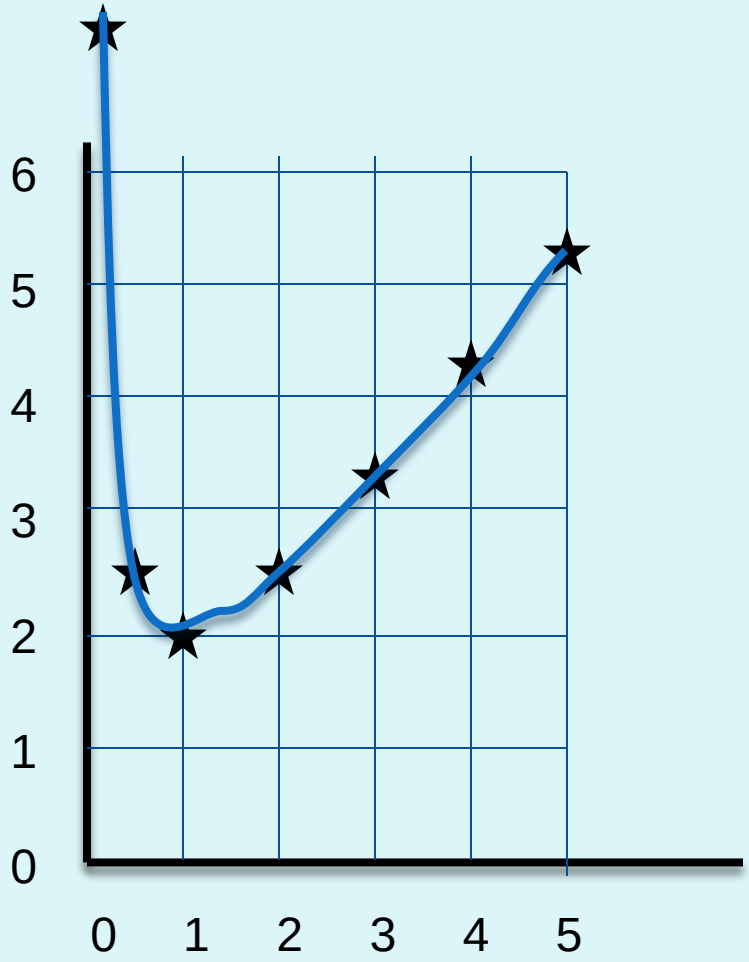
$$\frac{\left(p^2+1\right)}{p} \qquad \frac{\left(q^2+1\right)}{q} \qquad \frac{\left(r^2+1\right)}{r}$$

So, let us start with one equation only

Calculate and Draw

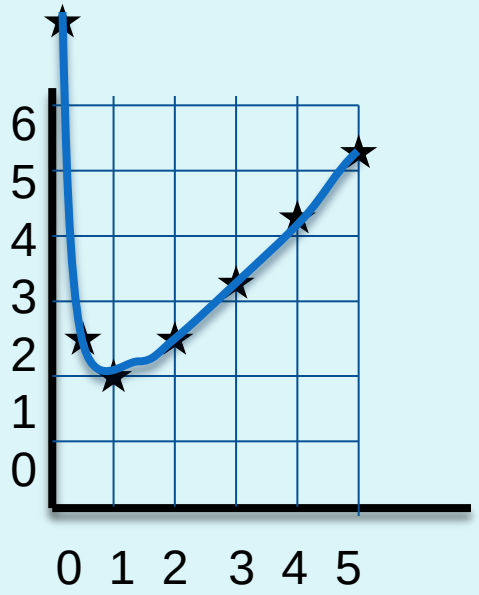
Draw $f(p) = \dfrac{\left(p^2 + 1\right)}{p}$

p	$f(p)$
0	Infinity
0.5	2.5
1	2
2	2.5
3	3.33
4	4.25
5	5.2



Finally

From the graph, $\frac{\left(p^2+1\right)}{p} \geq 2$



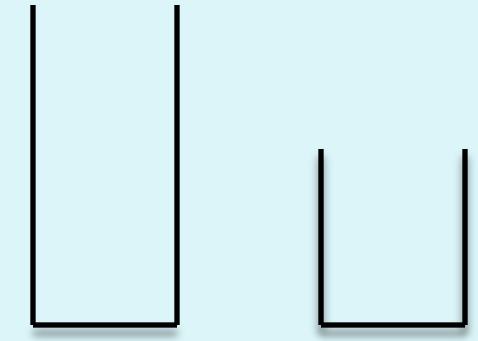
Therefore

$$\frac{\left(p^2+1\right)}{p}\frac{\left(q^2+1\right)}{q}\frac{\left(r^2+1\right)}{r} \geq 2\times 2\times 2$$

Or, $$\frac{\left(p^2+1\right)\left(q^2+1\right)\left(r^2+1\right)}{pqr} \geq 8$$

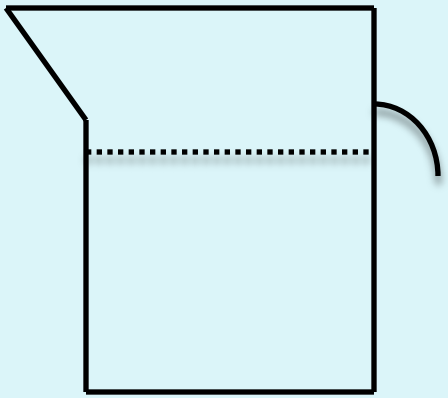
Problem 4

- Measure exactly 7 ounces of liquid from a large container using only 5-ounce container and an 8-ounce container.



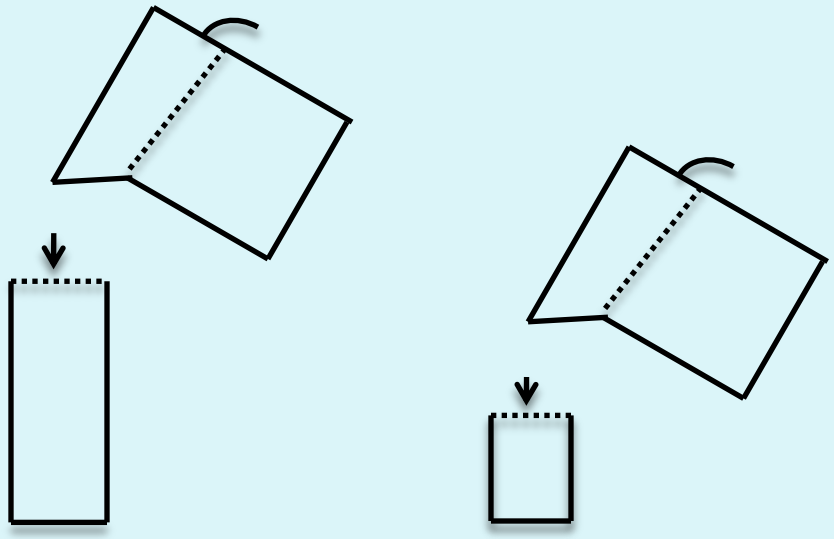
8 oz container

5 oz container



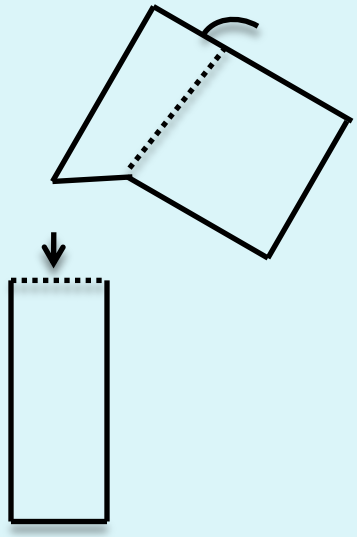
The obvious

- The obvious is that we can measure 8 oz and 5 oz



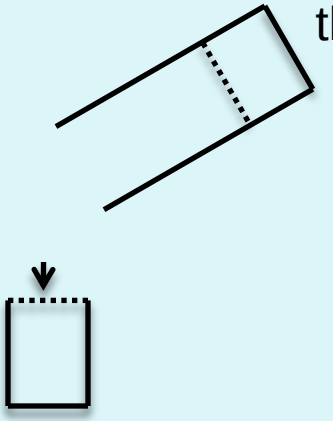
Device a plan!

- We can also measure 3 oz (difference between 8 and 5).



8 oz

Step 1



Pour from
the 8-oz

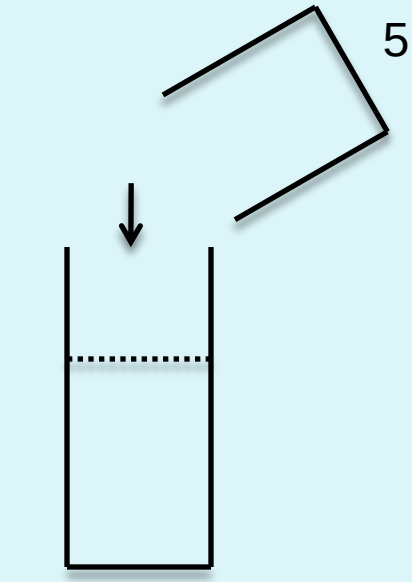
5 oz

3 oz left
In the
8-oz container

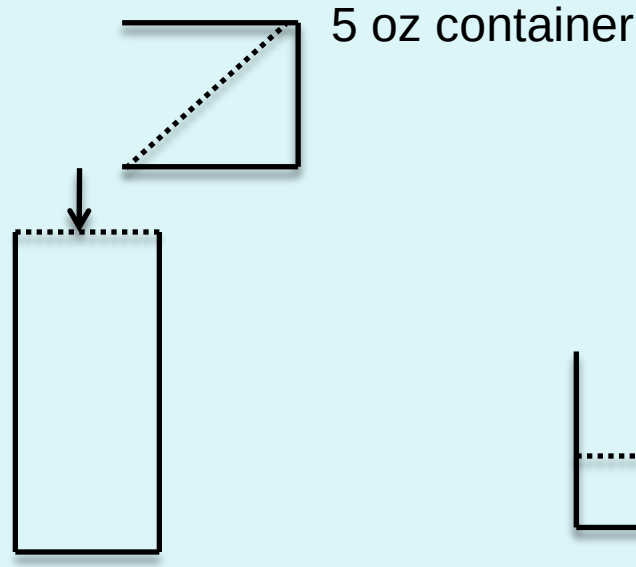
Step 2

Device a plan!

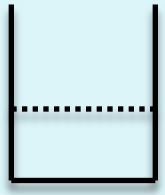
- Wait! We can measure 2 oz by filling the 5-oz full, pouring it in 8-oz.
- Then, filling the 5-oz full once more and pouring it in the 8 oz until its full. Then 2 oz will be left in the 5-oz container.



5 oz in the
8-oz container



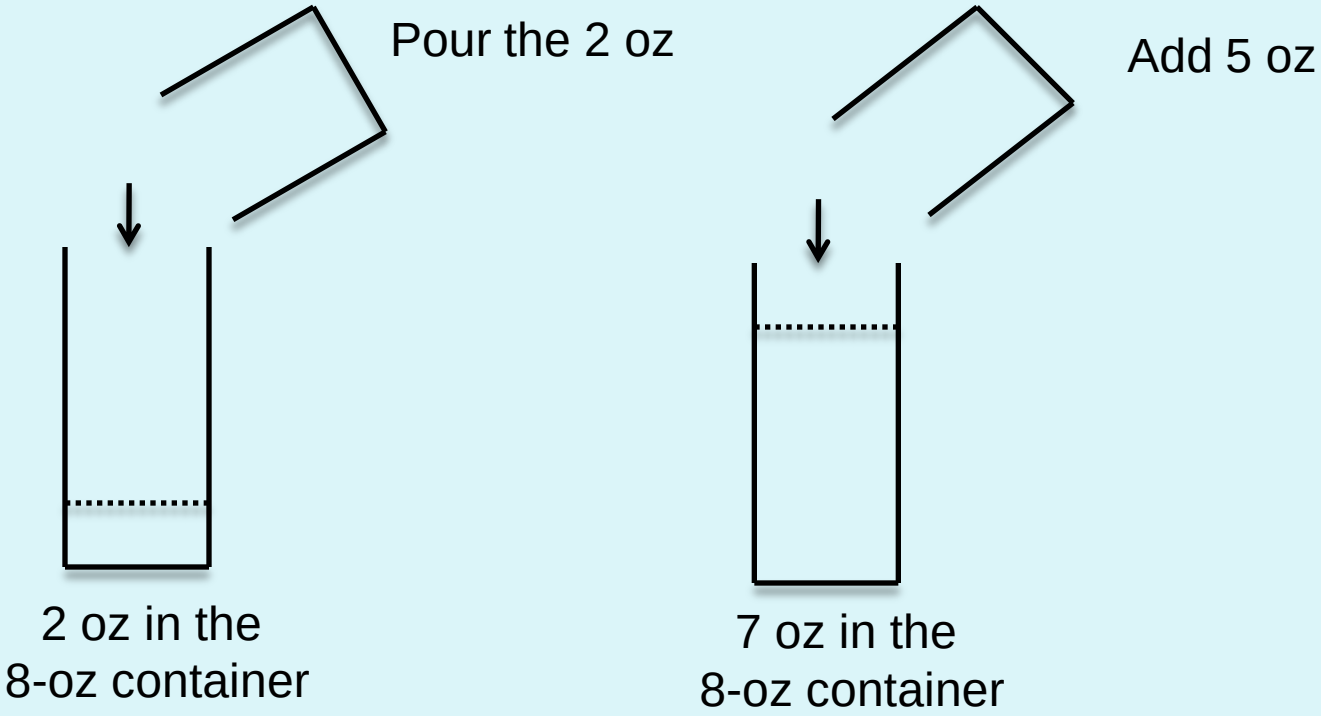
8 oz in the
8-oz container



2 oz left in the
5 oz container

The plan works

- Now, we know how to get 2 oz.
- We already know how to get 5 oz
- We are done!



Conclusion

- In this sequence, four problems were provided.
- In each problem, the correct solution was not apparent and therefore creativity in attacking the problem was needed.

References

- **Foundations of Engineering** by Holtzapple and Reece. McGraw Hill. 2nd edition 2003.

- *A review of creativity principles applied to engineering design* by Thompson and Lordan
- *Creativity for Engineers* by Rene Vidal
- *Stimulating Creativity* by Larry Richards.

- http://homepages.stmartin.edu/fac_staff/ijung/GE105