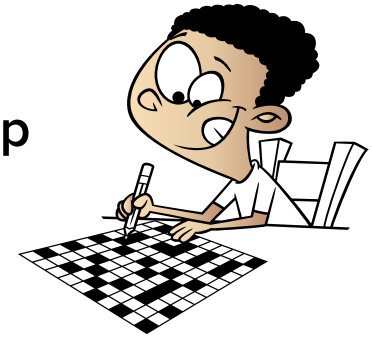

# Exercises

**“Celebrating the Power of Getting Things Wrong!”**



Sixteen Squares Warm Up

Nine Dots Sketch

Egg Drop

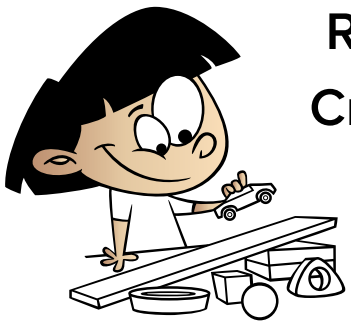
Marshmellow Challenge

Rube Goldberg Contraption

Create a NASA Space Diaper

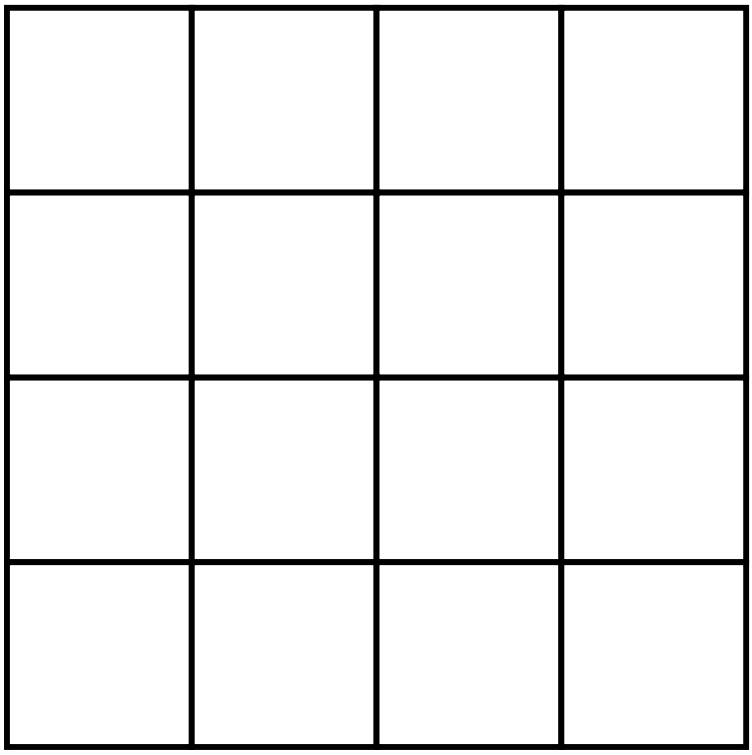
The **Never** Game

Smile Experiments



# Your LMF WarmUP!

How many squares do you see in this drawing? Remember, squares have four equal sides. Once you see one answer, look for a second answer.

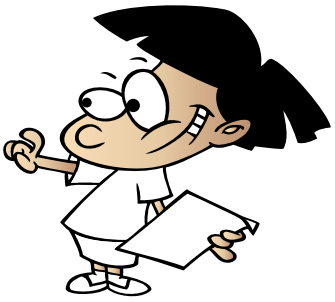


**Your first answer:** _____

**Now, look for more:** _____

**Look one more time:** _____

Your **FINAL** answer: _____



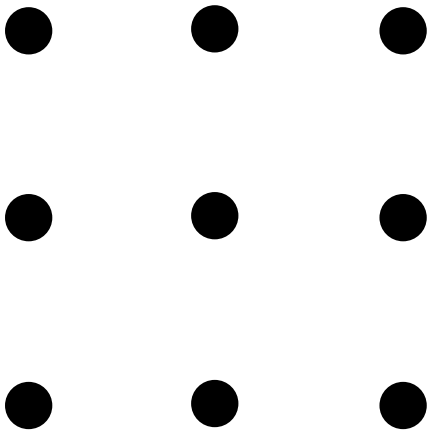
Here's the secret strategy to brainstorming. **Always look for second and third "right" answers.** Your first answer isn't always your best solution.

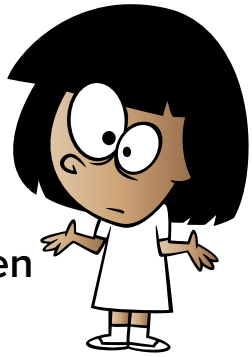
Puzzle answer is on the last page, please don't peek.

# Think Outside the Box

We will now stretch our minds **even more**. This exercise will show us why we need to think out of the box.

**Your goal:** Connect all nine dots using only four straight lines, without lifting your pencil off the paper! You can cross over lines, but no erasing or retracing.





**Stumped? Feeling frustrated?** Take a mindful breath, then look at the dots again!

Once you crack the code, think: What did this teach me about solving problems creatively?

Puzzle answer is on the last page. please don't peek.

# Let's Land an Egg!

**Without Breaking It!**

You are to build a container that will prevent a raw egg from breaking when dropped from a height of at least 9 feet. Your design will hopefully:

1. Reduce the final speed of the egg by using air resistance.
2. Increase the time of impact by using cushioning.

## Needed Materials:

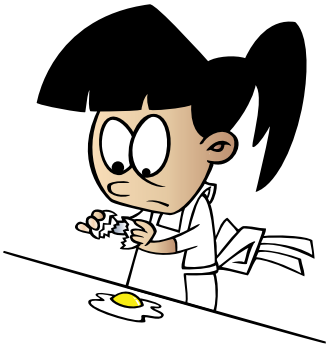
Each group of students gets the following:

- 2 balloons
- 2 small paper cups
- 4 straws
- 1 sq. ft. of plastic wrap
- 1 sq. ft. of aluminum foil
- 4 rubber bands
- 4 popsicle sticks
- 2 ft. of tape
- 1 egg
- 1 bull's eye floor target
- 1 floor covering (newspaper, tarp)
- 1 pair of scissors

## Guidelines:

1. If your egg breaks, **it will be a mess.** All teams are responsible for cleaning up after themselves!
2. Your container must be designed so the egg can be inserted easily before competing and quickly checked after the drop.
3. The egg must stay inside the structure throughout the drop.
4. The judges will provide the final competition egg at the time of the competition. It will be a grade A raw egg.
5. There can be no manipulation of the egg to strengthen it.

## Scoring Criteria:



1. All unbroken eggs beat all cracked or broken eggs.
2. All cracked eggs beat all broken eggs.
3. If the egg survives the first drop without breaking, the container can be dropped a second time to score more points.
4. If it survives the second drop without breaking, it can be dropped a third time.

The least materials used in building your structure get **10 bonus points** for every drop.

## First Drop:

| | |
|---|---|
| Hits the bull's eye | 10 egg points |
| Egg is unbroken and not cracked | 10 egg points |
| Egg shell is only cracked | 5 egg points |
| Egg is broken | -10 egg points |
| Container with least materials used | 10 egg points |

## Second Drop:

| | |
|---|---|
| Hits the bull's eye | 10 egg points |
| Egg is unbroken and not cracked | 10 egg points |
| Egg shell is only cracked | 5 egg points |
| Egg is broken | -10 egg points |
| Container with least materials used | 10 egg points |

## Third Drop:

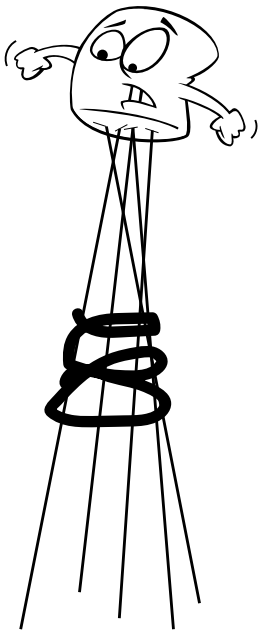
| | |
|---|---|
| Hits the bull's eye | 10 egg points |
| Egg is unbroken and not cracked | 10 egg points |
| Egg shell is only cracked | 5 egg points |
| Egg is broken | -10 egg points |
| Container with least materials used | 10 egg points |

**Total Egg Points Score: _____**

# Share:

What did you learn about **failure** doing this exercise?

# Marshmallow/Spaghetti Challenge



Here's a fun exercise to warm up your brain and build your teamwork skills.

## Design Challenge:

Build the tallest free-standing structure with a marshmallow on top using no more than twenty sticks of spaghetti, three feet of tape, three feet of string, and one marshmallow.

## The Rules:

1. The structure is measured from the tabletop surface to the top of the marshmallow. That means the structure cannot be suspended from a higher structure, like a chandelier.
2. The entire marshmallow needs to be on the top of the structure. No cutting or eating part of the marshmallow.
3. Teams can use as many or as few of the twenty spaghetti sticks, as much or as little of the string or tape.
4. Teams can break the spaghetti and cut the tape and string.
5. Teams cannot hold on to the structure after time runs out.

## Experiment (One):

Build the structure in just **ten minutes**.

After building, measure the height of your structure and test if it will support the weight of one marshmallow. The marshmallow must sit firmly on top of your structure.

Take photos of your structure and debrief the success or failure of your design and building process.

Then come up with three ideas for building a more successful structure in the future.

1.

2.

3.

## Experiment (Two):

Using your new ideas, build another free-standing structure with a marshmallow on top in just **ten minutes**.

After building, measure the height of your structure and test if it will support the weight of one marshmallow. The marshmallow must sit firmly on top of your structure.

Take photos of your structure.

## Analyze:

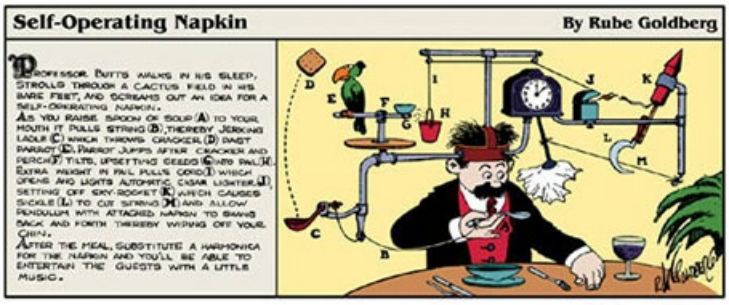
1. Were both building attempts successful?
2. Which building attempt was taller?
3. Which building attempt used fewer materials?
4. What building techniques made the tower stronger?
5. Does the size of the base alter the strength of the tower?
6. How do you think you worked as a group?

## Share:

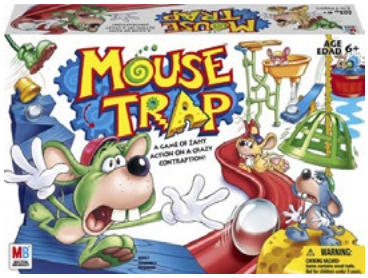
What did you learn about **failure** doing this exercise?

# Let's Build a Contraption

Rube Goldberg (1883-1970) was a cartoonist, sculptor, engineer, and inventor. Rube created wacky, complicated contraptions that performed simple tasks like opening an umbrella, scratching someone's back, or sharpening a pencil.

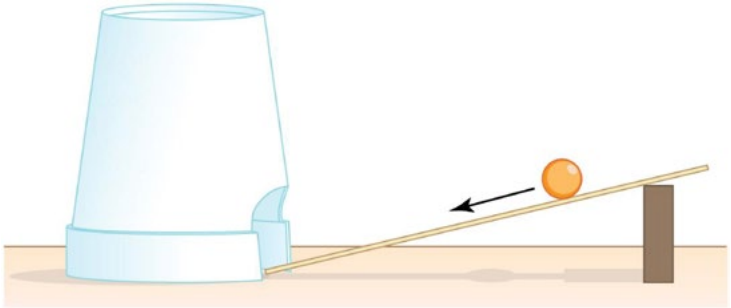



A Rube Goldberg contraption consists of a series of simple machines linked together to produce a domino effect, in which each device triggers the next one, and the original goal is achieved only after many steps.




You may be more familiar with his work than you think: If you've played the classic "Mouse Trap" board game, you've experienced the fun of Rube's creations.

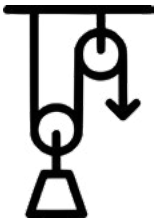
You are going to design and build a Rube Goldberg-like contraption **to put a marble into a paper cup**.



# What are Simple Machines?

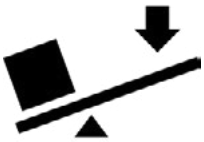
Here are examples of six simple machines:

1. What is a **PULLEY**, and how does it help us?



A pulley is a wheel with a groove that holds a rope or cable. It helps us lift heavy objects more easily, like when you use a flag pole to raise a flag.

2. What is an **INCLINED PLANE**, and how does it help us?

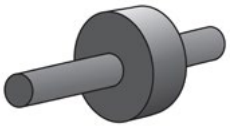


An inclined plane is a flat surface higher on one end, like a ramp. It helps us move heavy objects up or down, like rolling a heavy barrel up a ramp into a truck.

3. What is a **LEVER**, and how does it help us?

A lever is an extended object that pivots on a point, like a see-saw. It helps us lift heavy objects by applying force on one end, like using a crowbar to pry open a box.

4. What are a **WHEEL** and **AXLE**, and how do they help us?



A wheel and axle consists of a round object (wheel) attached to a rod (axle). They help us move things easily, like on a wagon, car, or bicycle.

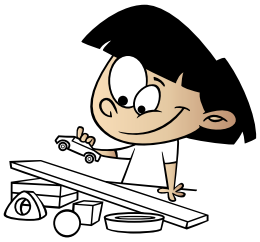
5. What is a **WEDGE**, and how does it help us?

A wedge is an object with one thick end that gets thinner towards the other end, like a doorstop. It helps us split things apart, like using an axe to chop wood.

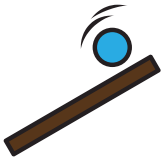
6. What is a **SCREW**, and how does it help us?

A screw is an inclined plane wrapped around a cylinder, like a bolt or a jar lid. It helps us hold things together or lift things, like screwing a light bulb into a socket to hold it in place.

Your contraption must:



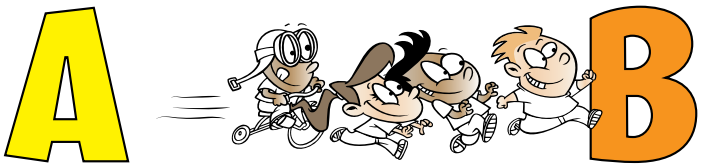
- Include at least **four** different **simple machines**
- Be made with recycled or repurposed materials
- Have at **twenty six** distinct **steps**
- Tell a story about the challenges you are trying to solve with these simple machines and how this exercise relates to everyday life challenges.



A step is defined as a single action or movement. For example, a marble rolling down an inclined plane would be one step, and putting the marble in the cup is another step.

## Why 26 Steps?

Rube Goldberg said most people go from point A to point B in life as quickly as possible.




He wanted to go from A to B, **using all the letters in the alphabet**, to see new ideas and experience life. There are 26 letters in the alphabet.

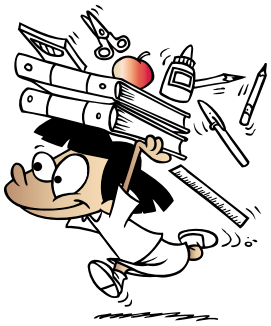
If you create a contraption with 26 steps, please email a video to woof@wagilabs.org, and you'll receive a cool prize and a social media spotlight for your contraption.

## Needed Materials:

All teams will need identical marbles and paper cups. You can use any additional materials you'd like, but please **DO NOT** go out and buy materials. The fun and creativity of a Rube Goldberg contraption comes from the challenge of working with and re-purposing everyday items.

Think about bringing:

| | |
|---|---|
| Cardboard | Clean Food Containers |
| Toilet paper rolls | Toy Cars |
| Egg cartons | Duct Tape |
| Legos | Scissors |
| String | Ruler |



You'll also want an adult, like a relative, family friend, or your favorite teacher, to review and judge your contraption using the provided criteria.

## Judging Criteria:

These points will be awarded based on the final run, and no points will be awarded on any practice runs.

Number of simple machines used ____ x 15 points = ____

Number of different materials used ____ x 15 points = ____

Number of fixes to complete run ____ x (-15 points) = ____

The challenge story you tell (up to 25 points) = ____

TOTAL _____

## Borrow Some Ideas

Here is a link to Rube Goldberg videos on YouTube that might give you some design ideas. It's OK to "borrow" the ideas demonstrated in the videos.

https://www.youtube.com/channel/UCp7FcZAAyqnBunO6eAAh8NQ

# Here is a successful contraption for turning on a light.


The twelve steps in the light chain reaction:

1. A boot kicks a bowling ball.
2. The bowling ball knocks over a bowling pin.
3. The falling pin pulls a rope to open a birdcage.
4. The escaping bird bumps a ball down a track.
5. The ball knocks over dominoes.
6. A domino falls into a truck.
7. The domino rolls down a seesaw.
8. The domino knocks over a hammer.
9. The falling hammer turns on a toaster.
10. The toast pops up and hits scissors, which cut a rope.
11. A weight falls onto one side of a balance.
12. The hand on the other side of the balance rises, flipping the light switch.

## It's Time to Brainstorm:

Your brainstorming goal is to devise creative ways to put the marble in the cup using as many steps as possible.

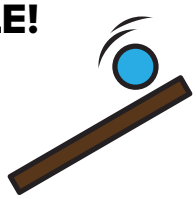
1. Each team member will work on their own for **20 minutes** and sketch a draft of a contraption and a story for what challenge you are trying to overcome.
2. The first step starts with releasing the marble, and the last step is the marble dropping into a cup.
3. Share your design with your team members.
4. As a team, decide which components you like from each person's design.
5. Combine your best ideas to sketch your team's contraption and the story your team will tell.

## Now, It's Time to Build:

1. Start building your contraption.
2. Label each step and simple machine used.
3. Give your turns and twists fun and descriptive names.
4. Celebrate success with sounds, flags, billboards, whatever you can dream up!
5. Do trial runs of the marble through the simple machines.
6. Tweak the machines to allow a flawless run of the marble into the cup.
7. Now, it's time to present your story and do your final run.

# It's Time to Present:

1. Every contraption needs to tell a story of overcoming a life challenge. What story does your machine tell?
2. You'll present your story before launching your final run in the competition.
3. Pick who the presenters will be.
4. Practice telling your story and following the story with a demonstration of your contraption.
5. Pick the guides that will help out if your marble gets stuck.
6. Now, **ROLL THE MARBLE!**



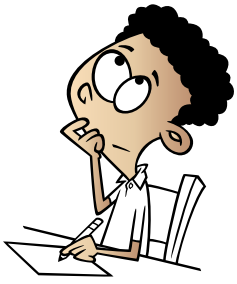
# It's Time to Share:

1. What did you learn from this exercise?

2. How did you use **STEAM** in building the contraption?

3. Did you experience what engineers call learning from "**trial and error**?"

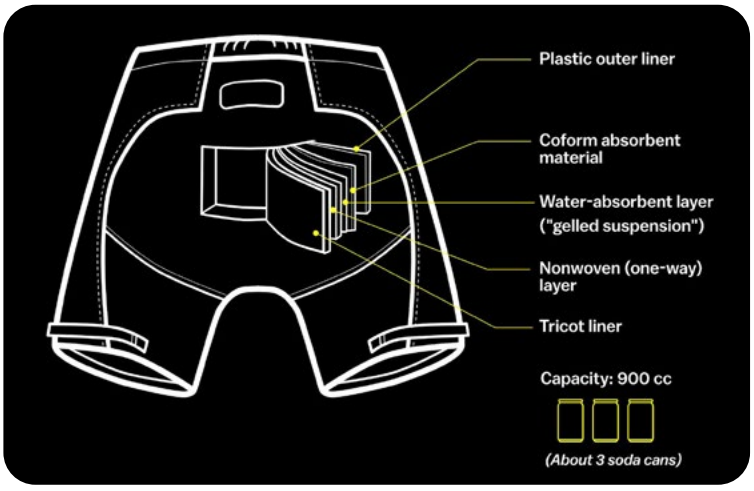
4. What ideas from this exercise can you apply to other life challenges?



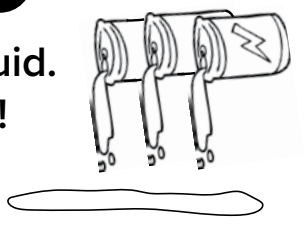
# Let's Create a Space Diaper!

Managing fluids in space come with a load of unique problems. So NASA developed a "Maximum Absorbency Garment" (MAG) for the shuttle program. They're sometimes called "space diapers."

MAGs are more like hyper-absorbent bike shorts. Several thin layers of material move urine quickly away from the body. Then sodium polyacrylate, a super-absorbent polymer (SAP) crystal material capable of taking on 400 times its weight in water, locks away the moisture.



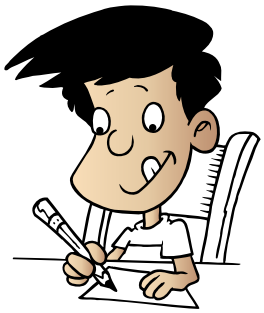

A MAG can soak up 2 liters — or 2.1 quarts — of liquid. That's like absorbing all the liquid in 3 cans of soda!



## Time to Brainstorm:

Can you think of five more uses for these super-absorbent polymer crystals besides NASA space diapers?

## Your Mission:



To experiment with different materials to determine their absorbency properties.

1. Are polycarbonate crystals the best absorber?
2. Rank all of the materials by best absorbency.
3. Rank all of the materials by cost.
4. What materials offer the best value based on the absorption and the cost?

## Needed Materials:

1. 10 small cups
2. Different absorbent materials:
    - Polycarbonate crystals
    - Cotton balls
    - Polyester stuffing
    - Clay powder
    - Paper towels
    - Sponges
    - Baking soda
    - Slica gel
    - Activated carbon
    - Cut up washcloths
3. Water and a water dropper
4. Notebook and pencil

## Time to Build:

1. Set up each material in a single cup and count how many drops of water are absorbed by the material.

    - Polycarbonate crystals _____
    - Cotton balls _____
    - Polyester stuffing _____
    - Clay powder _____
    - Paper towels _____
    - Sponges _____
    - Baking soda _____
    - Silica gel _____
    - Activated carbon _____
    - Cut up washcloths _____

2. Which material absorbed the most water drops?

3. Which material absorbed the least amount of water?

4. Which materials absorbed the liquid as you thought?

5. What other materials can you think of to absorb liquids?

6. Sketch your own  “Maximum Absorbency Garment.” It can be for any use you can think of and include your favorite absorbent materials.

7. What if you created a prototype of the MAG you designed?
    - How would you test your design?
    - How would you try it on?
    - How would you test it to see if it works?

When you test it out, you'll learn some essential information you can use to modify and improve your design.

## Time to Present:


Share your new, breakthrough "Maximum Absorbency Garment" with your classmates and tell them about its super absorption capabilities and comfortable design.

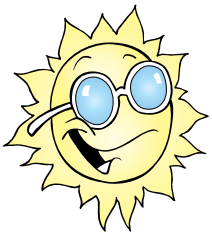
Listen to their feedback and make revisions to your design. Then present it to your family and friends. Look for more feedback to improve your design.

## Time to Journal:

1. What did you learn from these exercises?
2. How did you use **STEM** in creating your MAG?
3. What ideas from this exercise can you apply to other life challenges?

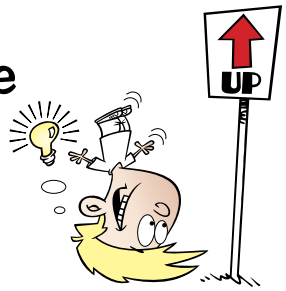
Suggested Time: 20 minutes

# The Never Game!

"The sun rises, the sun sets.
Everything goes to its opposite.
Learn to see things backward, inside
out, and upside down."

—Lao-Tzu




A **never** idea starts as something you would **never** do. But, with a little help, it can turn into an amazing idea!

Let's play the **Never Game** to discover the magic of turning a **never** idea into a possibility for a great idea.

First, answer the question, then flip the answer into a possibility you might consider.

## Where would I never want to go on vacation?

_____

Now **FLIP** it ...

Tell why your **never** vacation spot might be a cool idea!

_____

_____

## What would I never want to do today?

_____

Now **FLIP** it ...

Tell why your never activity might be a cool idea!

_____

Did “flipping” your ideas generate any new ideas?

Let’s see if playing the **Never Game** can help us think of new ways to solve a community challenge.

## Describe a community challenge?

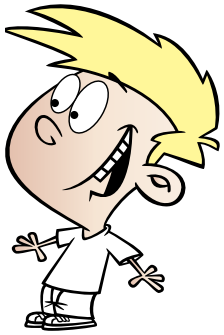
_____

## What would we never do to solve our challenge?

1. _____
2. _____
3. _____
4. _____
5. _____

Insert the “nevers” in the chart on the next page.

# NeverNever Land



**What would we never do to solve our challenge?**

## Never Do...

1. _____

2. _____

3. _____

4. _____

5. _____

Have fun! Be **silly**!!!

Now, look at your **never** ideas, and find a way to **FLIP** some of them to make great ideas to solve your community challenge.

## Idea Possibilities ...

1. _____ 

2. _____ 

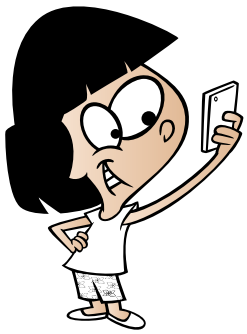
3. _____ 

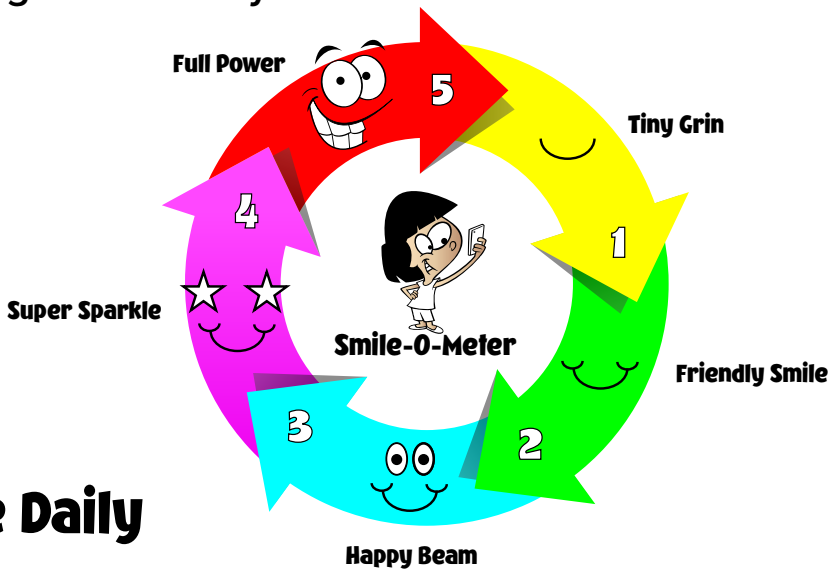
4. _____ 

5. _____ 

# Smile-O-Meter Exercise

Look in a mirror or use the camera on your phone and rate your smile from 1 to 5 throughout the day.






## Track Your Smile Daily

### Morning Check-In

Time: _____

My Smile Level (1-5): _____

What made me smile? _____

### Afternoon Update

Time: _____

My Smile Level (1-5): _____

What made me smile: _____

### Evening Reflection

Time: _____

My Smile Level (1-5): _____

Best smile moment today: _____

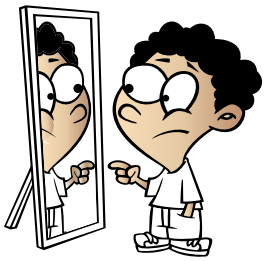
**Tomorrow's Smile Level goal:** _____

Suggested Time: 15 minutes

# A Smile Experiment

## Part 1: The Serious Face Test

1. Look in the mirror for 30 seconds with your most serious face
2. While looking serious, notice:



How your face feels: _____

What your eyes look like: _____

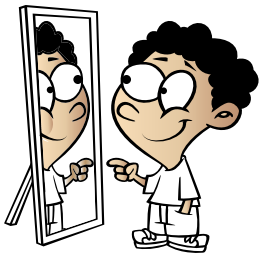
Your energy level (1-5): _____

Your mood (circle one): 😞 😐 😊 😄 🤗

## Part 2: The Smiling Face Test

Now, give your biggest, brightest smile for 30 seconds.

While smiling, notice:



How your face feels now: _____

What changed in your eyes: _____

Your energy level (1-5): _____

Your mood (circle one): 😞 😐 😊 😄 🤗

## Part 3: Draw Your Smile Map

Draw two faces below:

Your serious face

Your smiling face

## Part 4: Label the changes you notice:

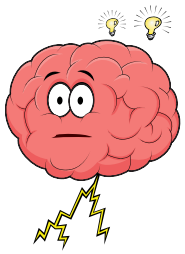
Where do you see wrinkles?

Which muscles moved?

What happened to your cheeks?

How did your eyes change?

# Smile Brainstorm Booster



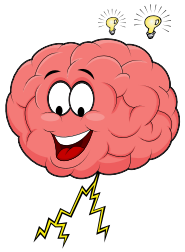
**Part 1: The Serious Brainstorm**

1. Set your timer for 3 minutes
2. Keep a serious face
3. Brainstorm ideas to help you get a better night's sleep?

Write three ideas:

1. Rate: _____
2. Rate: _____
3. Rate: _____

Rate each idea (1-5 stars): 🤗⭐⭐⭐⭐



**Part 2: The Smile Power Brainstorm**

1. Put on your biggest smile
2. Set your timer for 3 minutes
3. Think of three new solutions for the same challenge:

Write three ideas:

1. Rate: _____
2. Rate: _____
3. Rate: _____

Rate each idea (1-5 stars): ⭐⭐⭐⭐⭐⭐

**Compare Your Ideas**

1. Which ideas were more creative?
2. Which ideas were easier to think of?
3. Which ideas would be more fun to work on?

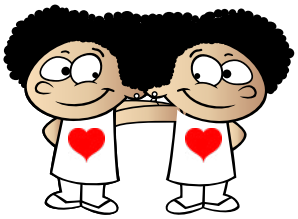
**Measure Your Idea Power**

Count your total stars: Serious _____ Smiling _____

Suggested Time: 20 minutes

# Smile Chain Compassion

Your smile can start a chain reaction of happiness!



**Part 1: The No-Smile Test**

1. Pick a busy place (like the cafeteria or playground)
2. Set a timer for 5 minutes
3. Walk around with a neutral face (no smile!)
4. Count:
   - How many people you see: ____
   - How many are already smiling: ____
   - How many smile at you: ____

**Part 2: The Smile Power Test**

1. Go to the same place
2. Set your timer for 5 minutes again
3. This time, share your friendly smile with everyone you see
4. Count:
   - How many people you smile at: ____
   - How many smile back: ____
   - How many start smiling at others: ____

**Calculate Your Smile Power:**

Smile Success Rate = (People who smiled back ÷ People you smiled at) × 100

My Success Rate = ____ ÷ ____ × 100 = _____%

**What I Learned:**

1. Where did my smile work best? _____
2. What kind of smile got the most smiles back? _____
3. How long did my smile chain continue? _____
4. What surprised me most? _____

# The Answer Page

**LMF WarmUp Exercise:** The answer is 30 squares. If you are looking at the graphic on a computer display then you can also count the pixels which are square. So that answer is based on the resolution of the monitor.

**Think Outside the Box Exercise**: