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Investigation #1: Solving Problems

Date: _____

Name: _____

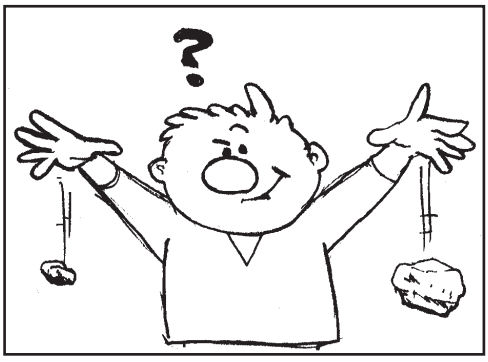
Class: _____

PART 1 - ENGINEERING DESIGN PROBLEM

Problem *Do big rocks fall faster than pebbles?*

Solution _____

Test Procedure



1. Hold the rock in one hand and the pebble in the other hand at the same height.
2. Drop the rock and pebble at the same time.
3. Record which one hits the floor first.
4. Repeat the test using the rock and the crumpled paper.

Test Results

Test #1

1. Rock and pebble - hit the floor first _____
2. Rock and paper – hit the floor first _____

Test #2

1. Rock and pebble – hit the floor first _____
2. Rock and paper – hit the floor first _____

Conclusion

Analyze your test results and form a new solution to this problem. _____

_____

_____

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PART 2: YO-YO FUN

Yo-Yo Care

1. Never scratch the axle with a knife or any sharp object. The scratch will cut through yo-yo strings as fast as you can put them on. A yo-yo with a scratched axle is not useable.
2. Do not pull your yo-yo apart. The gap (distance between the two yo-yo- halves) is set in the factory. When you pull the yo-yo apart, you weaken the bond between the yo-yo halves and the distance between them will probably change.
3. Use only genuine Duncan Yo-Yo strings. Kite string, twine, thread, etc. will not work properly. Most toy and hobby stores, along with yo-yo.com sell Duncan strings with the yo-yos.
4. Replace your yo-yo string when it begins to get dirty. The strings will last longer if your hands are clean when you use your yo-yo.

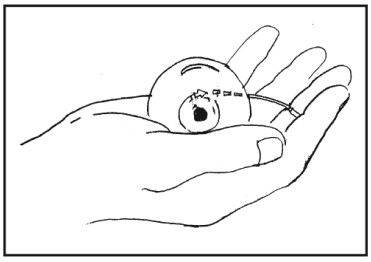
Yo-Yo Safety

1. Be aware of your surroundings and how close other people are to you.
2. Stay away from others and objects that can break while you are learning to control you yo-yo.
3. Do not swing your yo-yo around your head. Doing this could hurt someone or break something. This is not yo-yoing.

Prep Your Yo-Yo - (Tutorials available on-line at: yo-yo.com)

1. Your partner will hold their yo-yo hanging toward the floor while you cut the string four inches above their waist. Switch jobs and repeat this.
2. Both of you will tie a simple knot in the end of the string, then make a loop.
3. Open the two strands of string just below the knot tied.
4. Pass the yo-yo string through this opening. This forms an adjustable loop, or slip knot, that goes behind the first knuckle of your middle finger.
5. To wind the yo-yo, gently wind the string until it catches inside the yo-yo. Then finish winding the string up the rest of the way.

How to Yo-Yo - (Tutorials available on-line at: yo-yo.com)



1. Hold the yo-yo in your hand with your palm up.
2. Flick the yo-yo off the end of your wrist with a snap.
3. While it is spinning at the bottom of the string, turn your hand over and give the string a jerk.
4. The yo-yo will return to your hand.
5. You probably won't get it to spin the first time. Keep practicing to get it to spin, or sleep.

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Date: _____

Investigation #2: Pendulums

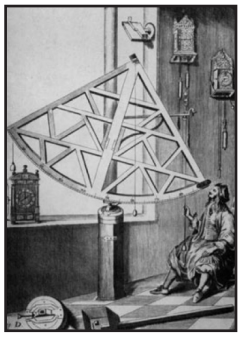
Name: _____

Class: _____

Problem *What can change the period of a pendulum?*

Solution _____

_____



Test Procedure

Only use one variable per test.

1. **Heavy Weight Group: Slip two yo-yos into the loop of string and compare it to a single weighted yo-yo's period.**
2. **Pull Back Further Group: Suspend a yo-yo over a ruler. Carefully pull the yo-yo back six inches (15 cm), then 18 inches (46 cm). Measure and compare each period.**
3. **Grasp the String Group: Measure the period when the string is grasped 15 inches (38 cm) from the yo-yo and 30 inches (76 cm) from the yo-yo.**

Test Results

1. **Heavy Weight: 1 Yo-Yo** _____ **2 Yo-Yos** _____
2. **Pull Back Further: 6 ins.** _____ **18 ins.** _____
3. **Grasp the String: 15 ins.** _____ **30 ins.** _____

Conclusion

Did your test prove or disprove your solution? _____

_____

_____

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Investigation #3: Potential & Kinetic Energy

Date: _____

Name: _____

Class: _____

PART 1: FLYWHEELS

Problem *What will happen to a button on a button flywheel when you pull the string apart?*

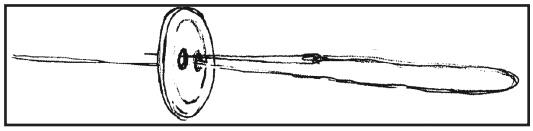
Solution _____

_____

Test Procedure

Make A Flywheel

1. Pull the thread through the button's holes. If it is a four-hole button, use diagonal holes.
2. Tie the ends of the thread together.
3. Slide the button to the middle of the looped string.
4. Take one end of the loop in each hand and twirl the button around 20 or 30 times. The thread will get twisted.
5. Pull the string apart.

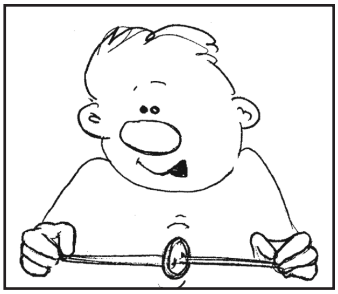


Test Results

1. What happened? _____

_____

2. How long can you keep the button spinning? _____



This test demonstrates that while the string is twisted, it contains only Potential Energy. When the string is pulled, the Potential Energy begins to convert to Kinetic Energy as the button begins spinning. The Kinetic Energy is converted back to Potential Energy as the button winds the string again. The button is acting like a flywheel and storing energy.

Conclusion

Potential Energy is stored energy, energy waiting to happen. Kinetic Energy is energy in motion. Fill in the blanks below with the correct type of energy.

Kinetic or Potential Energy

The button at rest with the thread twisted contains _____ Energy. Pulling the ends apart makes the button start to spin. This spinning button has _____ Energy. As the button twists the string, it is converting _____ Energy to _____ Energy. Finally, the button has wound the string very tight and stopped spinning. Now the system Possesses only _____ Energy.

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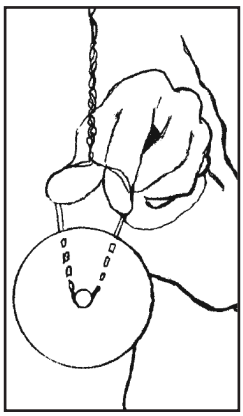
PART 2: ENERGY AND THE YO-YO

Problem *What will happen when you drop the yo-yo?*

Solution _____

_____

Test Procedure



1. Turn the yo-yo into a flywheel by making it so it will not sleep. Form a double loop of string about the axle. Grasp the string 2 inches above the yo-yo. Twist the yo-yo counter clockwise until the string opens. Form a double loop of string about the axle (like double looping a rubber band around a newspaper). Let the yo-yo hang at the end of its string for 30 seconds as the string will re-tighten to the proper tension.
2. Put the yo-yo string on your finger.
3. Wind the yo-yo up and hold it in your hand palm down.
4. Drop your yo-yo. Do not jerk your hand.
5. Continue holding your hand out until the yo-yo completely stops.

Test Results

1. Was your solution correct? _____
2. Where does the yo-yo have the most Potential Energy? _____
3. Where does the yo-yo have the most Kinetic Energy? _____
4. Where was Potential Energy converting to Kinetic Energy? _____
5. Where was Kinetic Energy converting to Potential Energy? _____
6. Why doesn't the yo-yo return all the way to the hand? _____
7. How could you make the yo-yo return all the way to the hand? _____

_____

Conclusion

Draw a picture of a yo-yo going down.

1. Label the type of energy the yo-yo has at the top of the string and at the bottom of the string.
2. Label where Potential Energy is converting to Kinetic Energy.
3. Label where Kinetic Energy is converting to Potential Energy.

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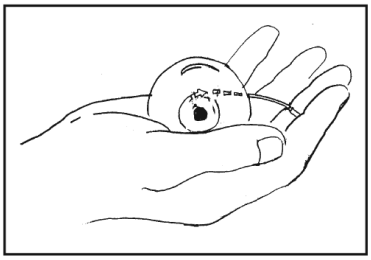
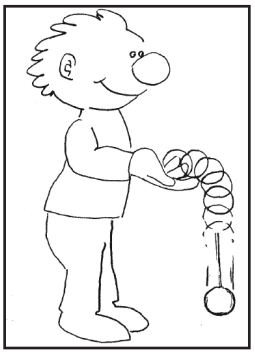
Throwing the Yo-Yo and a Few Tricks

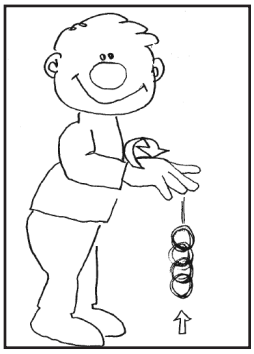
1. ***Gravity Gripper*** – This is when you just drop the yo-yo described in the Test Procedures for Energy and the Yo-Yo.



2. ***How to Throw the Yo-Yo*** – A) Make a slip knot and place over index finger. B) Hold the yo-yo in your hand palm up. Make sure the string is wound over the top of the yo-yo. Throw the yo-yo off the end of your hand. When the yo-yo hits the bottom of the string, quickly turn your palm down to catch the yo-yo. How hard can you throw the yo-yo and still catch it?

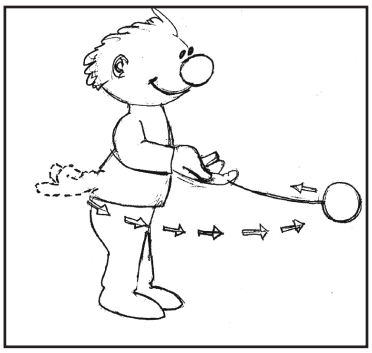
3. ***Forward Pass*** – Put the yo-yo string on your finger. Wind the yo-yo up and hold it in your hand palm down. Begin with your hand at your side. Flip the yo-yo straight out in front of you. Before it returns, turn your hand palm up to catch it.





4. ***Loop-the-Loop*** – Begin with the Forward Pass, but instead of catching the yo-yo when it returns, flip your hand sending the yo-yo out into another loop. After flipping the yo-yo out, wait until the yo-yo returns to within five inches from your hand. Point your fingertips first toward your nose, then your toes. Keep the motion in your wrist and watch your yo-yo loop and loop again.

5. ***Making the Yo-Yo Spin*** – Hold the yo-yo palm up with the string wound over the top of the axle. Flick the yo-yo down like you did with the "Gravity Gripper". The yo-yo will spin at the end of the string. To get it to come back up, turn your hand over (palm down) and give the yo-yo a slight upward tug. If you threw it hard enough, the spinning yo-yo will wind itself all the way up the string back into your hand.



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Investigation #4: Collecting and Analyzing Data

Date: _____

Name: _____

Class: _____

Problem *How can you determine your own average Base Line Spinner Duration?*

Solution _____

_____

Test Procedure

1. Get a partner. One person will throw a Sleeper (Spinner) while the other person watches a stopwatch or clock.
2. The watcher partner will say "GO" and the other partner will throw the yo-yo.
3. The thrower will say "STOP" when the yo-yo returns to their hand.
4. The watcher will write down the number of seconds that elapsed. If there is a bad throw, record a zero.
5. Repeat procedure numbers two through four for nine more times.
6. Add up all the results and divide by ten. The answer is the average Spin Time or Base Line.
7. Change jobs and repeat the Test Procedure so each person has a Base Line.

Test Results

Test #1		Test #2	
1.	_____ seconds	1.	_____ seconds
2.	_____ seconds	2.	_____ seconds
3.	_____ seconds	3.	_____ seconds
4.	_____ seconds	4.	_____ seconds
5.	_____ seconds	5.	_____ seconds
6.	_____ seconds	6.	_____ seconds
7.	_____ seconds	7.	_____ seconds
8.	_____ seconds	8.	_____ seconds
9.	_____ seconds	9.	_____ seconds
10.	_____ seconds	10.	_____ seconds
Base Line:	_____ seconds	Base Line:	_____ seconds

Conclusion

1. Why did you throw the yo-yo ten times? _____

2. In scoring many sports, the high and low scores are discarded. Take your data, throw out the high and the low, then average the remaining observations. Remember to add the eight observations, then divide by eight not ten. Did the results change? _____ Why? _____

_____

_____

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Investigation #5: Spin Wars!

Date: _____

Name: _____

Class: _____

Problem *What tests can you do that will result in the longest spinning yo-yo possible?*

Solution _____

_____

Test Procedure

The Spin Wars! Competition will find the longest spinning yo-yo in your class. To prepare for Spin Wars! you will do non-structured testing with your yo-yo. Think about everything that makes a yo-yo spin and use these problem questions to plan your testing.

1. **Why does a yo-yo slow down and eventually stop?** _____

2. **What can you do to stop or minimize this slowing process?** _____

3. **Will that help your yo-yo spin longer?** _____

4. **What if you could throw your yo-yo harder?** _____

5. **Can you modify your throw to get longer spins?** _____

6. **Does the weight of the yo-yo affect its spin?** _____

7. Does the length of the string affect the spin? _____

8. How can you change your throwing technique to affect the spin? _____

Test Results

What test or tests helped your yo-yo spin longer? _____

Spin Wars! Results

Spin #1: _____ seconds

Spin #2: _____ seconds

Conclusion

What did you find is the best way to make a yo-yo spin longer? _____