

Asking Better Questions & Motion

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Welcome to the 2nd module of The Creative Parent's Toolbox! In this module you will learn

- (1) how to ask questions that make others think, and
- (2) the Physics of Motion.

What you will learn

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	Pedagogy	Physics Concepts
Module 1	Building a Growth Mindset	Forces
Module 2	Asking Better Questions	Motion
Module 3	Engineering Design Process	Structures
Module 4	Motivating Learners	Flight
Module 5	Gender Biases	Electricity
Module 6	Creating an Ideal Learning Environment	Power

Building Creative Minds for the Future

The basic skills needed for tomorrow are the
“higher level” ones of
creativity, curiosity & persistence.

Fostering these skills is not just the school's
responsibility.
It is also the parent's.

21st Century Thinking Skills

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Grow your child's mind

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<https://youtu.be/zLp-edwiGUU>

Talk to your child.

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You may have seen this ad from PNC bank, about how parents are their children's primary source of information for the first five years.

Asking
Open-Ended Questions
that do not have
one right answer builds
creativity.

Open ended questions are questions that do not have one right answer. The opposite of an open-ended question is a closed question -- a closed question can be answered with either a single word or phrase.

Asking open-ended questions can be a powerful way to foster key traits and skills -- such as creativity -- as a child must think beyond the obvious or immediate answer and come up with their own explanation.

Why are open-ended questions good for your child?

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Improve brain functioning

Develop mental skills that lead to academic success

Lay the groundwork for mathematical and scientific reasoning as well as for reading and writing

Teach children to express themselves effectively

Boost standardized test scores

Help children analyze and process information

Prepare children for leadership positions

Develop creativity and problem solving abilities

This list is from “Is your bed still there when you close the door? How to have intelligent and creative conversations with your kids” by Jane Healy.

Another reason that open-ended questions are good for your child is that they are one of the best ways to encourage an open-mind towards learning:

Additional Advantages of Open-Ended Questions:

- permit an unlimited number of possible answers
- permit creativity, self-expression, and richness of detail
- reveal a learner’s logic, thinking process, and frame of reference

(http://www.amazon.com/Still-There-published-Doubleday-Hardcover/dp/B008V0LYQA/ref=sr_1_2?s=books&ie=UTF8&qid=1431895572&sr=1-2&keywords=jane+healy+is+your+bed+still+there)

Open-ended questions provoke thought

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Please watch this video about the value of open-ended questions

Wait 5-10 seconds after asking a question

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Wait Time

The concept of "wait-time" was introduced to teachers by Mary Budd Rowe (1972). She found that typically teachers waited less than 1.5 seconds after asking a question. She found, however, that when these periods of silence lasted at least 5-10 seconds, many positive things happened to students' and teachers' behaviors and attitudes, such as:

- Students gave much longer answers
- Many other students responded with relevant answers
- Students' confidence increased.
- Students asked more questions.
- Student achievement increased significantly.

Apply this with your own children -- give them time to think and respond after you ask them a question.

Types of questions

DI- VERGENT Questions

Develop **CRITICAL THINKING** skills.

DEFEND
Why do you
THINK SO?

PREDICT
What do you think
WILL HAPPEN?

CON- VERGENT Questions

ONLY ONE correct answer to...

JUDGE
Which
do you think
IS BETTER?

OPINION
What do you
THINK?

CREATE
How would you
DO THIS?

**CAUSE &
EFFECT**
If...
THEN... ?

WHAT?
WHO? WHY?
HOW?
WHERE?

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Divergent questions develop critical thinking -- these questions don't require one specific answers, but rather exercise one's ability to think broadly about a certain topic. On the other hand, convergent questions require only one correct answer. Use this guide and exercise making divergent questions as you build designs with your child.

Prepare some good questions

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Cause & Effect	If we use a heavier ball in this machine, what do you think will happen?
Create	What type of shape do you think we should use for this cam?
Opinion	What do you think of this design?
Judge/Compare	Which shape do you think is better?
Defend	Why do you think that shape will do better?
Predict	What can I do to make it even better?

The left-hand column are kinds of questions you can ask. The right hand column has an example of each kind of question. Before you begin building a challenge with your child, take some time to prepare strong, open-ended questions that you can ask as you build -- you can use this slide as a guide, if you get stuck!

Practice Asking Open-Ended Questions

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There are many opportunities to practice asking open-ended questions in daily life. For instance, reading together is a great time to ask questions. Instead of simply reading the book aloud, engage everyone at different stages in the story -- ask for their thoughts and opinions, or ask them to predict what's going to happen next. This is also a great way to encourage critical thinking!

Motion and Machines

Another great place to practice open-ended questions is when exploring and building together!

There is nothing quite like the satisfaction of making something new with your brain and hands - especially if that new thing moves.

You probably already understand what motion is -- but can you describe it? In physics motion is the change in position of an object over time but we can also simply describe Motions as movements. When something is moving it has motion.

Let's try to apply what we know about forces to motion.

A roller coaster doesn't have an engine. How does it go so fast?

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Roller coasters are good examples of the physics of motion. They continue moving in the direction of the track until a force acts upon them and slows them down.

What force acts to slow them down? It's gravity!

Watch this video of a roller coaster ride, and pay attention to the motion of the roller coaster:

Notice how roller coasters start by going really high into the air, and then drop down moving in all different directions. Finally, when it reaches the bottom of the inclined track and gravity isn't forcing it to move downward anymore, it simply stops!

Watch this video to see a rollercoaster in motion:

<https://www.youtube.com/watch?v=QM1IQidriF4>

Basic ideas

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- An object in motion tends to **stay** in motion
- An object at rest tends to **stay** at rest

... unless a force acts on the object

Motion tends to keep on keeping on.

Objects that are moving tend to keep moving in the same direction until a force acts upon it. The same is true with objects that are at rest, or not moving. Objects that aren't moving tend to keep not moving until a force makes them move.

Let's think of some examples you can use to demonstrate this idea with your kids:

https://openclipart.org/image/300px/svg_to_png/171995/sport-2.png

<https://edifiedasdm.files.wordpress.com/2012/02/9155015-cartoon-teen-relaxing-on-the-sofa-he-is-eating-a-snack-and-has-a-soft-drink-handy.jpg>

Forces



change



Motion

Motions are movements, anything that is moving. Something will continue to move until an outside forces is applied. So, you can say that Forces change Motion!

Let's apply this idea--watch something moving and identify the force that changes the speed or direction of the object moving. For instance what force is acting when something slows down? If I roll a ball across the floor, eventually it will slow down without touching anything except the surface it's rolling on. The slowing force here is *friction*. Friction is a force of resistance that a moving object encounters when it moves through or on something else. The rolling ball slows down because the floor texture rubs against the ball's surface and because the ball pushes through air molecules in order to move.

<http://www.athletico.com/blog2/wp-content/uploads/2012/04/Runners.jpg>

Motion Transfer Machine!

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Watch this video to see another cool thing about motion -- it can be transferred from one object to another without being lost. We already know that an object in motion will stay in motion until a force acts on the object to stop its motion. And as this video demonstrates, an object can transfer its motion to another object as well.

So now that we know a little about motion, let's start thinking about how we can use motion to make cool projects. Let's make machines that transfer motion, like the example in the video above!

Move!

Here's a great exercise for you to do with your kids (and it's especially great for when they have extra energy to burn off before bed)!

Let's practice observing motions using our bodies right now -- get up and move around. Look at the direction that your bodies are moving. Up and down, forward and backward, in a circle, etc. How many different motions can you do?

Try to think about the forces that you're creating in order to make these movements, and what forces you need to use in order to stop or change them. How can you use forces to (gently) change another person's motion?

The Sultan's Elephant

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Now let's learn a little bit more about machines and motion together. Machines rely on the forces of motion to work. Machines are made up of many different moving parts that work together to perform one task. These different moving parts can be called mechanisms. Mechanisms work together to transfer the motions from one place to another. Each mechanism performs a simple motion, but when put together, many mechanisms can create a more complex motion to make a machine work.

Long Ma the Mechanical Dragon breathes fire & smoke - all through mechanisms

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Watch this video of Long Ma, a mechanical dragon that breathes fire and smoke. Long Ma has many different mechanisms that help it move in many different ways. For extra credit, watch this video that shows how some parts of the robot were built: <https://youtu.be/PDJMZVcdNfc> (it is a little scary, so you might want to watch it alone first before sharing it with your children)

<https://www.youtube.com/watch?v=qjaFwki0OLU>

Some more mechanisms that use cranks and cams

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Let's practice watching motions being transferred by machines. Machines can be big or small-- the machines in this video are small automatons -- small machines that move to perform a simple task.

As you watch this video, try to identify where the motion is starting and where it transfers.

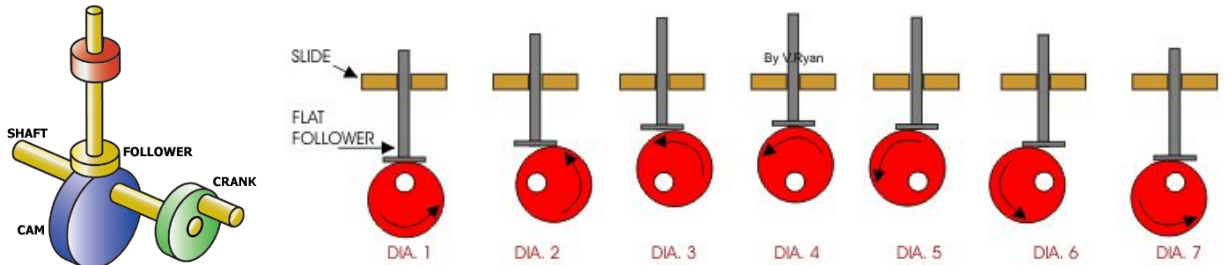
Look at the specific mechanisms -- not only are they really cool they can also teach us a lot about how motions can be transferred.

Looking at Mechanisms

Machines transfer different types of motions. Motions can move in lines, circles or even in zig zags. Let's start looking at smaller mechanisms which are parts of machines and look at the motions we can observe.

You can change a rotary motion into an up & down motion using cranks and cams

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- Notice where the hole is placed in the "cam". Would the stick move up and down if the hole was in the center?
- Why do you think we need to put a "slide"?

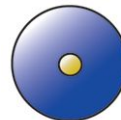
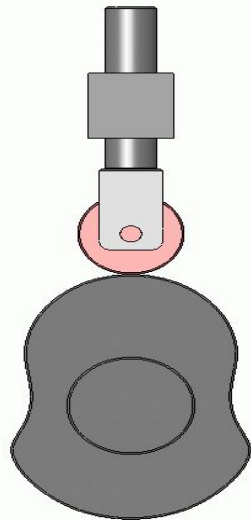
Rotational motion is a movement that is circular. Look at the this cam mechanism. The motion starts on the red circle, the cam. When the cam moves rotationally, it touches the cam follower and transfers the rotational motion to a linear (up and down) motion.

<https://msc-ks3technology.wikispaces.com/Cams>

<http://www.technologystudent.com/cams/cam10.htm>

Cams of all shapes

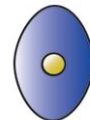
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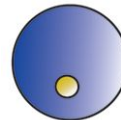
ROUND



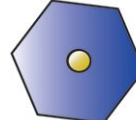
EGG-SHAPED



ELLIPSE



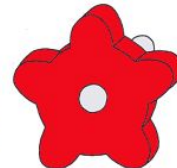
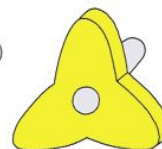
ECCENTRIC



HEXAGON



SNAIL



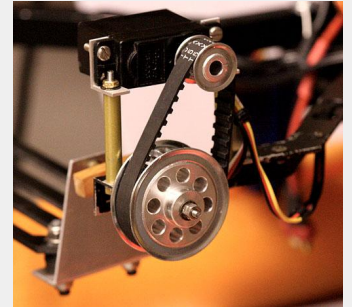
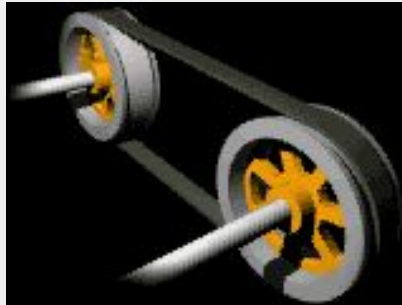
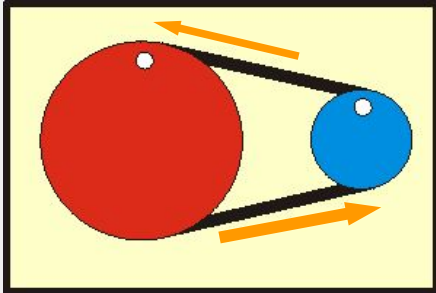
Cams can be made in a variety of shapes -- the shape of a cam can affect how quickly the motion is transferred.

http://upload.wikimedia.org/wikipedia/commons/5/53/Cam-disc-2_frontview_animated.gif

<https://msc-ks3technology.wikispaces.com/Cams>

Belt & Driver Pulley

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Notice the speed of the red disc. Is it going faster or slower than the blue disc? Why do you think that happens?

A crank can be attached to one wheel that rotates that one. Because of the belt, we are able to move the second wheel.

This is an example of how mechanisms can change the motion of an object. Look at the first picture with the red and blue wheels. They are connected with a belt so when one wheel moves so does the other. However the size of the wheel affects the speed that it is moving. It takes longer for the belt to go around the red wheel than the smaller blue wheel so it will be move slower. Motion is being transferred between the two wheels through the belt yet the size changes do speed that they are moving.

<http://wsdt.wellingboroughschool.org/resources/DTonCD1/school/mechanisms/pulleys/pulleyanimation.gif>

<http://wsdt.wellingboroughschool.org/resources/DTonCD1/school/mechanisms/pulleys/pulleyanimation.gif>

The Motion of Flowers

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Motion and forces also occur in nature. You can observe how objects move in your backyard or in a park. Since we know we are looking for movements, let's practice observing movements not just in machines but in nature too. For instance, flowers -- we've seen flowers bloom, or spread open, which is a kind of motion. But how do they do it?

The outer cells grow faster than the inside ones

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Click on the blooming flower to see an animation of how a single petal curves. It does that because the cells in the outside of the petal grow and expand faster than the inside, causing an instability and a strain - which results in the flower opening - very slowly.

<https://vimeo.com/51972132>

Get ready for the challenge. Prepare some open-ended questions

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Which do you think is better? (Judge/Compare)

What do you think? (Opinion)

How did you do this? (Create)

Why do you think so? (Defend)

What do you think will happen? (Predict)

If . . . , then . . . ? (Cause & Effect)

A mechanical story: The Sultan's Elephant & the Little Giant Girl

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This is a cool (20 min video) to show your children to get inspired and excited about building mechanisms.

<https://youtu.be/Bc0PoWfPzml>

Congratulations!

You just finished the
second module!

Pick one challenge

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Build a Rube Goldberg Machine



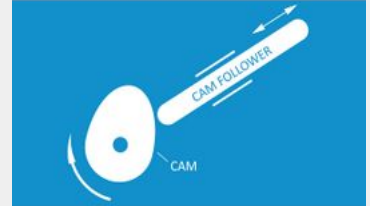
Build a machine that accomplishes a task in an inefficient way.

Build a Blooming Flower



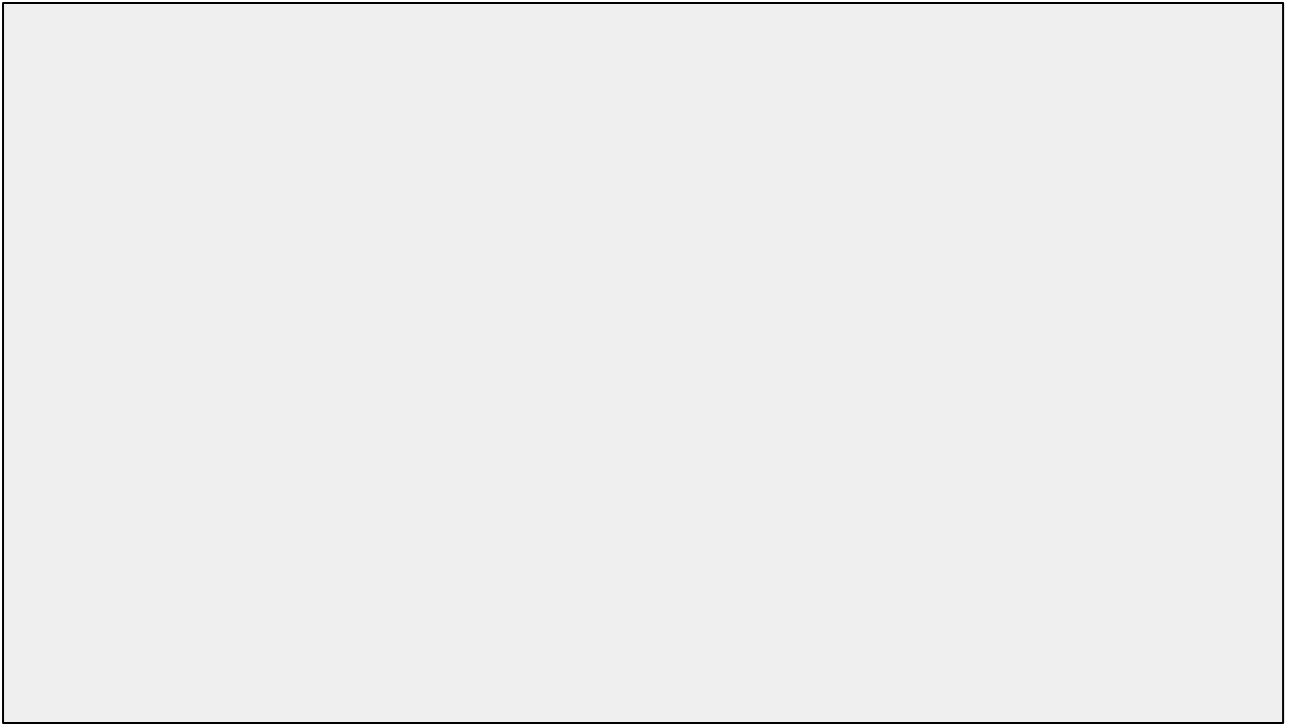
Build a flower that can open to communicate with pollinating insects and birds.

Build a Cam Mechanism



Create a simple machine that transfers a rotational motion into a linear vertical motion.

Let's do your own design! Pick one of these design challenges and build a moving machine to test out forces yourself!



How do we know that the Earth is moving?

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The Earth is always moving because it is in a gravitational orbit around the sun. Without any forces to stop it, it will keep moving at the same speed indefinitely or until an outside force acts upon it!

(Please explain this further -- things like -- what motions act on the earth? and what direction is it traveling?)