MS;PS2-1
MS.PS2-2

1. Observe Phenomenon:
https://www.ngssphenomena.com/#/woodpecker-slowmo/
https://www.ngssphenomena.com/#/slinky-free-fall/
https://www.ngssphenomena.com/#/changing-forces/

2. Gather (Students gather data and more information about the phenomenon) Students observe the phenomenon and develop questions to investigate the causes for the patterns they observe.
Write questions:

3. Reason (Students make sense of the data and information and construct an explanation) Students develop a model of the relevant natural system to explain the causes for the observed patterns.

Draw a model to represent what you learned about speed, velocity, and acceleration using symbols and text. Use a Chromebook and notes. **Models need Labels.**

4. Communicate Reasoning (Students communicate the explanation and how evidence supports the explanation) Students individually construct a written explanation supported by evidence why (causes) . Students communicate their individual explanations and group models to the class and engage in argument from evidence to find the best explanation.

Driving Questions:

What parts of the model are moving?

How could you measure the movement?

How did you use speed, motion, and acceleration in your model.

5. Complete the following Group Performance Tasks:

- Take turns to read (literally) what you wrote and use your model to help communicate your explanation.
- Engage in argument from evidence as to which of your explanations is the better or more complete one.
- Make eye contact with someone in the room that you have not worked with.
- Bring your written explanation and model and introduce yourself

Similarities	Differences

Name________________________ Observe Phenomenon

1. **Which model and explanation is more complete? Make sure that you cite specific evidence.**

Static Electricity – Station Activities

MS.PS2-3
MS.PS2-5

You will be performing experiments at a variety of stations. You may not get to every station. This is OK. For each station you are to:

1. **Tell what you did.**
2. **Record your observations.**
3. **Try to explain what you observed. (Think about the charges of each object before they are brought together.)**

*****After each experiment discharge all materials. Before you begin each experiment you may wish to see how the uncharged materials react when placed near each other.**

Station 1 – Balloon Power

1. Place the aluminum can on its side.
2. Rub the balloon on your shirt or hair.
3. Hold the balloon behind the side of the can about 5 cm above it.
4. Move the balloon slowly towards the can keeping it at a constant height.
5. Record your observations and explain.
6. Experiment further.

Station 2 – Walling Around

1. Rub the balloon on your shirt or hair.
2. Place the balloon against the wall so that the rubbed side touches the wall.
3. Release the balloon.
4. Record your observations and explain.
5. Experiment further.

Station 3 – Rule on Rule

1. Grab the suspended ruler in the center near where it is being suspended.
2. Rub **both ends** of the suspended ruler thoroughly with a sheet of wax paper.
3. Rub **one end** of the **second ruler** thoroughly with the wax paper.
4. Hold the second ruler near **either** end of the suspended ruler.
5. Hold the second ruler near the **other** end of the suspended ruler.
6. Place the ruler down, and move your hand near either end of the suspended ruler.
7. Record your observations and explain.
8. Experiment further.

Station 4 – Combing Water

1. Turn on the water so that a fine stream is flowing.
2. Rub the comb with the cloth towel or fur for about 30 seconds.
3. Move the comb near the stream of water without making contact.
4. Move the comb up and down slowly parallel to the water stream.
5. Record your observations and explain.
6. Experiment further.

Station 5 – Twin Balloons

1. Rub the suspended balloon on the "X" with fur for about 30 seconds. Release the balloon.
2. Rub the second balloon on the "X" with fur for about 30 seconds. Hold the balloon.
3. Try to touch the "X" on the second balloon to the "X" on the first balloon.
4. Try to touch the "X" on the second balloon to the back of the first balloon.
5. Record your observations and explain.
6. Experiment further.

Station 6 – Paper Dance

1. Rub the plastic lid of the container with fur for about 30 seconds.
2. Shake the container gently.
3. Observe the punched paper inside the container.
4. Record your observations and explain.
5. Experiment further.

Station 7 – Tape Together

1. Tape 2 strips of cellophane tape (each about 8 cm long) to the desk so that about 3 cm of each piece hangs over the edge.
2. Hold both pieces firmly by the hanging portion.
3. Pull both pieces quickly off the table at the same time.
4. Bring the pieces together slowly.
5. Record your observations and explain.
6. Experiment further.

Station 8 - Salt and Pepper

1. Sprinkle some salt onto a plate.
2. Bring a charged balloon near the salt. What happens?
3. Sprinkle some pepper on the plate so that you have a mixture of salt and pepper.
4. Bring your charged balloon near the pile of salt and pepper particles.
5. Record your observations and explain.
6. Experiment further.

Record Data

S1	
S2	
S3	
S4	
S5	
S6	
S7	
S8	

Is there a that field that exists between objects that exerts a force on each other even though the objects are not in contact?

C	I claim....	This is where you answer the question	
E	My evidence	This is where you cite relevant information	

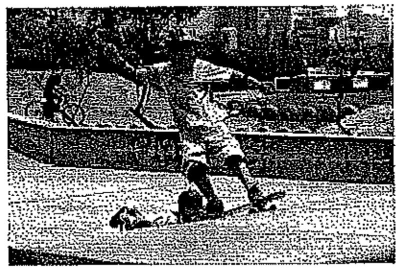
R	My reasoning ….	This is where you show that you understand the science! To do this well, state the science concept(s) (law, equation, etc.) and connect the claim and the evidence using the concept you stated. (Paragraph)	

MS.PS2-4
MS.PS3-1
MS.PS3-2
MS.PS3-5

Middle School Energy Skate Park Lesson

Name________________________________Date____________Period____________

ENERGY SKATE PARK



Learning Goals:

- Develop a model to describes how when distance changes, different amounts of potential energy are stored in a system.
- Examine how kinetic and potential energy interact with each other.
- Interpret graphical displays of data to describe the relationships of kinetic energy to the speed of an object
- Describe how energy can be transformed and apply to real world situation.
- Examine how friction affects the motion of objects

Instructions: Open up the PhET simulation "Energy Skate Park Basics."
Either type in http://www.colorado.edu/physics/phet/dev/html/energy-skate-park or Google "PhET Energy Skate Park Basics."

PART A-Designing a Skate Park

- Click on the "**Playground**" tab. Explore the simulation by clicking and dragging the tracks in order to make different loops and hills.

- List what variables you are able to change in the simulation:

____

- Create a track with at least on hill and one loop. Draw your design in the space below. DO NOT start your skater on your track until you draw it!

- Place your skater at the top of the track. Did your skater complete the track? Explain what happened in the space below:

____

____

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PART B-Potential Energy and Kinetic Energy

- Click on the **"Intro"** tab. Explore the simulation. List the variables that you can change in the space below:

____

- Using the simulation, describe or draw how you can change the amounts of potential energy in the table below. (make sure that you have either the pie chart or bar graph checked):

Most Potential Energy	
Least Potential Energy	

- Using the simulation, describe or draw how you can change the amount of kinetic energy in the table below:

Most Kinetic Energy	
Least Kinetic Energy	

- In the table below, describe what happens to the potential and kinetic energy of the skater when he is on different parts of the track (make sure that you have either the pie chart or bar graph checked):

Position of Skater	Amount of Potential Energy	Amount of Kinetic Energy
High on the track	☐ Increases ☐ Decreases	☐ Increases ☐ Decreases
In the middle of the track	☐ Increases ☐ Decreases	☐ Increases ☐ Decreases
At the bottom of the track	☐ Increases ☐ Decreases	☐ Increases ☐ Decreases

- What claim can you make about the relationship between the relationship between kinetic energy and potential energy?:

____

____

____

- What is your evidence?

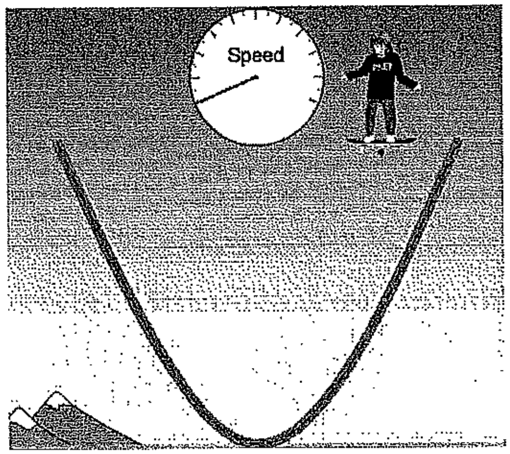
____

____

____

SPEED, POTENTIAL ENERGY, KINETIC ENERGY

- On the diagram below, label where you think the speed of the skater will be the greatest.



- In the table below, describe what happens to the speed of the skater when he is on different parts of the track (make sure that you have speed checked):

Position of Skater	Amount of Potential Energy	Amount of Kinetic Energy	Speed of Skater
High on the track	☐ Increases ☐ Decreases	☐ Increases ☐ Decreases	
In the middle of the track	☐ Increases ☐ Decreases	☐ Increases ☐ Decreases	
At the bottom of the track	☐ Increases ☐ Decreases	☐ Increases ☐ Decreases	

- What claim can you make about the relationship between the relationship between potential energy, kinetic energy, and speed?

____

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- What is your evidence?

____

____

TOTAL ENERGY

- In the space below, find ways you can change the total energy in the simulation.

PART C-Friction

- Click on the **"Friction"** tab. Explore the simulation. List the variables that you can change in the space below:

- In the table below, describe the motion of the skater when you change the amount of friction (make sure that you have either the pie chart or bar graph checked):

Action	Motion of Skater	Observations
Lots of friction	☐ Increases ☐ Decreases	
No friction	☐ Increases ☐ Decreases	

- Make a claim about how friction affects the motion of the skater in the space below:

- What is your evidence?

PART D-Designing a Skate Park

- Click on the "**Playground**" tab. If the skater was not able to complete the track, revise your design. Make sure to include on hill and one loop. Draw your revised design in the space below:

- On your design, label the points on the track where the potential energy of the skater is the greatest (PE).
- Label the points on the track where the kinetic energy of the skater is the greatest (KE).
- Label the points on the track where potential and kinetic energy are equal (PE=KE).
- Label the points on the track where speed is the greatest (S).
- In the space below, explain how potential energy, kinetic energy, and friction affected your track design:

____

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Summary, Reflection:

1	Scientific concepts covered in the simulation:
2	Examples of how each was used in the simulation:
3	Questions I still have, interesting things I learned:

Activity Sheet
Chapter 6, Lesson 11
Chemical Reactions & Engineering Design

Name ____________ MS.PS1-6
MS.PS3-3
Date ____________ MS.PS3-4

DEFINE THE PROBLEM

Imagine that you volunteered to rescue reptiles (turtles, snakes, and lizards) that are in the unlucky position of living in the path of new construction. Typically in these cases, animals move. They search for new homes and food sources nearby. However, eggs cannot crawl, slither, or swim to another location. And construction projects will not wait for eggs to hatch.

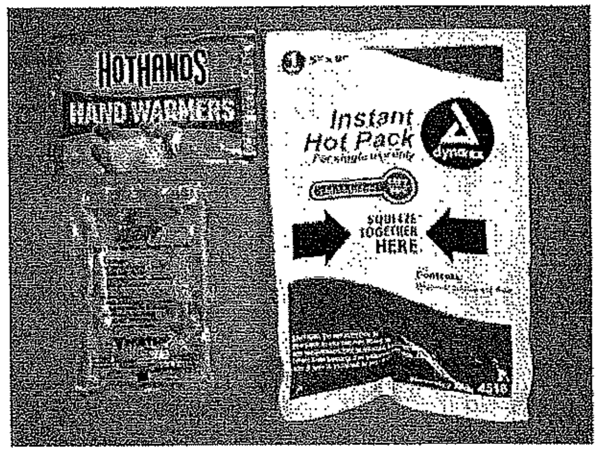
You have talked with the construction workers and with a nearby reptile conservation center. The workers are willing to notify you when they come across reptile eggs. The center is able to incubate the eggs until the babies hatch and then return them to the wild. Your role is to design a reptile egg incubation device that keeps an egg warm and safe as it is transported from the worksite to the reptile conservation center.

Reptile eggs are leathery and soft. While they are not prone to crack easily, they need to remain in the same orientation they were originally laid—whatever is facing up, must stay facing up. They cannot be flipped, turned, or jostled. Very importantly, the eggs must be kept warm, but not too warm, to properly develop and hatch.

You have a job to do before the first batch of eggs is found—build a temporary portable reptile egg incubator device that will keep one egg warm and properly positioned while you take it to the reptile conservation center. Let's give these young lizards, turtles, and snakes their best chance at life!

1. Inspiration for an invention can come from just about anywhere. Sometimes it can come from products that already exist.

   What features of the three hot packs shown in the video keep them from getting hot before you want them to?



2. The features that the device must have are called the *criteria*. As you begin to think about a temporary portable reptile egg incubator, what features might be useful to borrow from the design of the hot packs?

3. Possible problems that might prevent the design from successfully meeting all the criteria are called *constraints*. What are possible constraints, or challenges, which would prevent you from getting the features you listed above?

DEVELOP POSSIBLE SOLUTIONS

Think back to the story about transporting reptile eggs from a construction site to a reptile conservation center. Read the text message from one of the construction workers in the illustration to the left.

4. Take a look at the Reptile Egg Identification chart on the next page to answer the following questions:

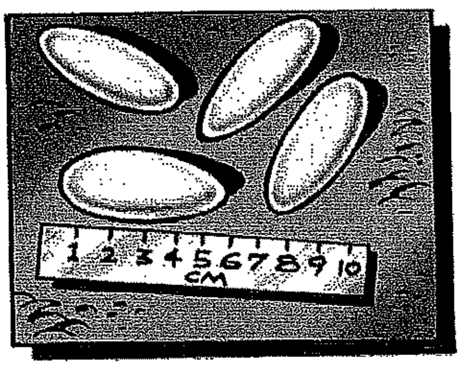
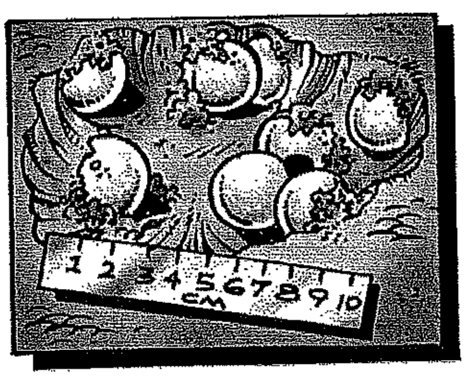
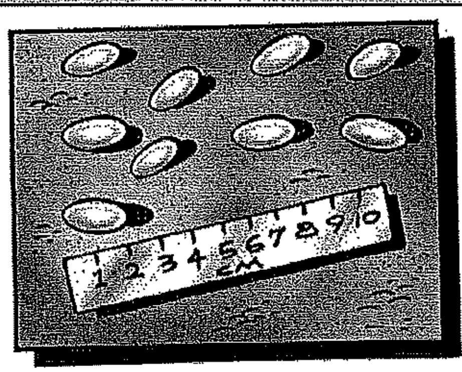
a. Do these eggs belong to a snake, turtle, or lizard?

b. What characteristics helped you identify these eggs?

c. As you design your temporary portable reptile egg incubator, you will need to consider the ideal temperature the reptile eggs need. What temperature range should you aim for when you mix calcium chloride, baking soda, and water?

Reptile Egg Identification Chart

Reptile eggs have a leathery shell and are found on or just under the ground. Care must be used when handling them, because they can be quite fragile. Also, the eggs should never be turned over: Whichever part is facing up must always face up until the reptile has hatched. Turning the eggs over could harm the developing embryo!

Snake		
	**Location** Snake eggs are found in a hidden location on top of soil, dried leaves, or mulch.	**Length** 4-10 cm
	Shape Snake eggs are oblong and irregularly shaped.	**Incubation temperature** 28-32°C
Turtle		
	**Location** Turtle eggs are buried in loose soil. A spoon and paint brush can be used to carefully remove these.	**Length** 2-5 cm
	Shape Turtle eggs are about the size and shape of ping pong balls.	**Incubation temperature** 24-28°C
Lizard		
	**Location** Lizard eggs are laid on soil, mulch, or dried leaves.	**Length** 1-3 cm
	Shape Lizard eggs are oblong and irregularly shaped.	**Incubation temperature** 26-30°C

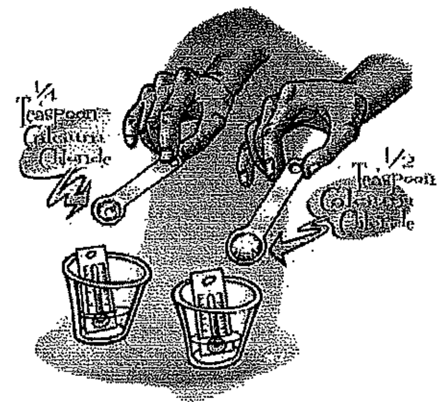
Question to investigate

Does the amount of calcium chloride dissolved in water affect the temperature change?

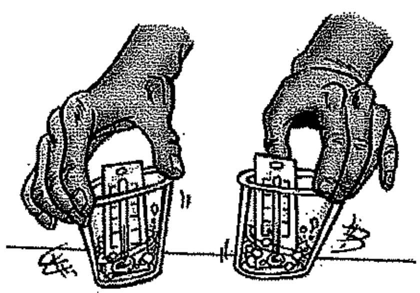
You will need

- Goggles
- 2 small thermometers
- Calcium chloride
- Baking soda
- Water
- 2 small clear plastic cups
- 1 graduated cylinder
- Measuring spoons (⅛ tsp., ¼ tsp., and ½ tsp.)

Procedure



1. Pour 15 mL of water into each of two small clear plastic cups.
2. Place a small thermometer in each cup and record the initial temperature in the chart below.
3. With the help of a partner and at the same time, add ¼ tsp. calcium chloride to one cup and ½ tsp. of calcium chloride to the other cup.

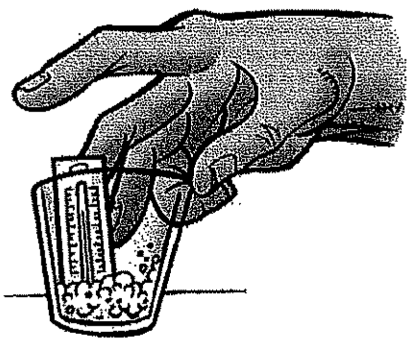


4. With the thermometers still in the cups, gently swirl both cups and check the temperature of both. Record the highest final temperature each reaches.

How much does the temperature increase?		
	¼ tsp. calcium chloride	½ tsp. calcium chloride
Initial temperature Just water	°C	°C
Final temperature Water plus calcium chloride	°C	°C
Change in temperature Final temp.– Initial temp.	°C	°C

Procedure, continued

5. Add about ⅛ teaspoon of baking soda to the solution that reached the highest temperature. Watch the solution and the thermometer.



6. With the thermometer still in the cup, gently swirl and check the temperature. Record the lowest final temperature reached.

How does baking soda affect the temperature of the calcium chloride solution?	
Temperature of the calcium chloride solution from Step 4	°C
Calcium chloride solution plus ⅛ teaspoon baking soda	°C
Change in temperature	°C

Should we use baking soda in the design of a portable reptile egg incubator?	
Disadvantages	Advantages

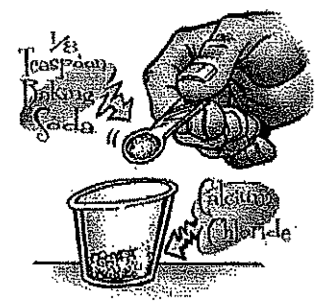
Question to investigate

About how much calcium chloride, baking soda, and water should be mixed to reach the right temperature range to incubate snake eggs?

You will need

- Calcium chloride
- Baking soda
- Measuring spoons (⅛ tsp., ¼ tsp., and ½ tsp.)
- 2 small clear plastic cups
- Water
- Thermometer

Procedure



1. Place ½ tsp. of calcium chloride in a cup.
2. To the same cup, add ⅛ tsp. of baking soda.
3. Swirl the cup to mix these dry ingredients.
4. In a separate cup, add 15 milliliters of water, place a thermometer in the cup, and record the temperature.

5. With the thermometer in the cup, add all of the mixture of calcium chloride and baking soda and gently swirl to mix.
6. Record the final temperature.
7. Adjust the amount of calcium chloride or baking soda and try the reaction two more times to achieve the target temperature.

About how much calcium chloride, baking soda, and water should be mixed to reach the right temperature range to incubate snake eggs?			
Calcium chloride	½ tsp.		
Baking soda	⅛ tsp.		
Water	15 mL	15 mL	15 mL
Initial temperature Just water	°C	°C	°C
Final temperature Highest temperature reached	°C	°C	°C

DEVELOP POSSIBLE SOLUTIONS

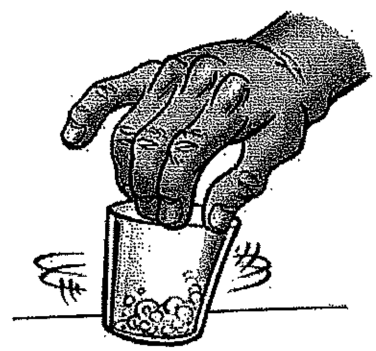
Would the chemical reaction you tested in this lesson work if it were sealed in a plastic bag? Sealing the chemicals in a plastic bag would mean that you would be able to bring just the portable reptile egg incubator with you rather than carry all the supplies needed for each of your tests. In this lesson, you will combine calcium chloride and baking soda in a zip-closing plastic bag to see if this design will keep reptile eggs warm enough.

Question to investigate

Does enough heat transfer through the plastic bag to reach the right temperature range?

You will need

- Calcium chloride
- Baking soda
- Measuring spoons (⅛ tsp., ¼ tsp., and ½ tsp.)
- Graduated cylinder
- 2 small clear plastic cups
- Small zip-closing plastic bag
- Water
- Thermometer



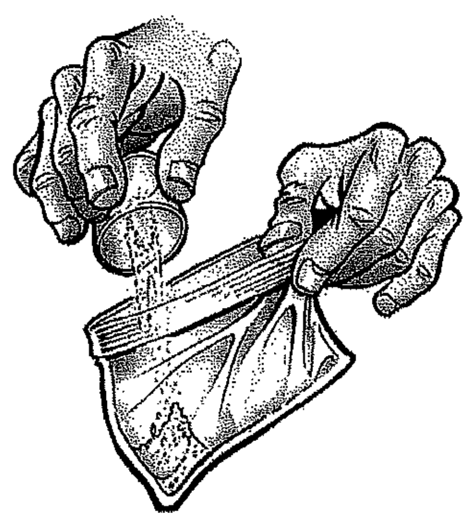
Procedure

Combine chemicals in a cup

1. Place the amount of calcium chloride and baking soda, which resulted in the best temperature in the previous procedure, in a cup.
2. Swirl the cup to mix these dry ingredients as well as you can.

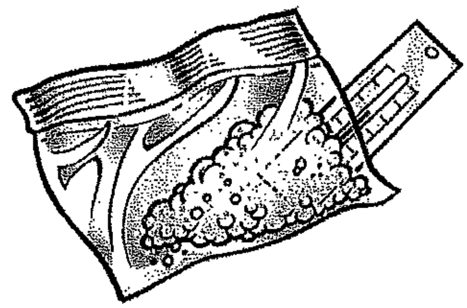
Prepare the bag

3. Pour the combined powders into one corner of a small zip-closing plastic bag. Tilt the bag so that all the calcium chloride and baking soda stays in one corner.



4. Use your fingers to seal off that part of the bag.
5. Have your partner pour 15 milliliters water into the other corner of the bag so that the water does not touch the dry powders.
6. While keeping the water and powders separated, try to get the air out of the bag as you close it and make sure that it is tightly sealed.

Start the chemical reaction



7. Let go of the corner and tilt the bag so that the water and the powders mix and react.
8. Position a thermometer under the bag so that the bulb is beneath the solution where the chemical reaction is taking place. Be sure you can read the temperature without having to remove the thermometer. Record the highest temperature reached.

What temperature does the thermometer reach when it is placed beneath the solution where the chemical reaction is taking place?	
Final temperature Highest temperature reached	°C

5. Since the plastic bag will be part of the portable egg incubator, enough heat needs to transfer through the bag to the egg. Does enough heat transfer through the bag to warm a snake egg enough?

6. The bag inflates slightly. How could this feature be useful in the design of the portable snake egg incubator?

OPTIMIZE THE DESIGN

7. Draw your design for a temporary portable snake egg incubator in the large space below. In your drawing use captions to point out how your device meets the following requirements:

   - Keep the egg at the ideal temperature for as long as possible
   - Hold the egg in the proper orientation
   - Protect the egg from impact

Reptiles rescued!

Congratulations, your device works! It was used to take the snake eggs from the construction site safely to the reptile conservation center. The eggs were carefully placed in incubators and both the temperature and humidity were ideal for the growth of healthy snakes.

Because most reptiles are able to feed and take care of themselves as soon as they hatch, the baby snakes will be taken to a new location and released into the wild. There they will make their new home as they strive to survive and thrive.

