Adapted to STEMAZing ECE Format by
DaNel Hogan
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Director of The STEMAZing Project

Paper Helicopters

Materials
Paper Helicopter Templates (large and small – printed on regular paper)
Paper clips
Clothespins (plastic or wood)
Scissors

Key Question
What affects how long paper helicopters stay in the air?

Learning Objectives
Children will…

- make paper helicopters and play with them.
- explore how changing the paper helicopters impacts how long they stay in the air.
- compare different paper helicopter designs by letting them race down from an elevated location like the top of stairs, a balcony, or on top of playground equipment (if available).

Vocabulary (See **What the heck? Explanation of Science** at the end for definitions.)
Helicopter Blades

SAFETY CONCERNS

- Throwing the paper helicopters and collecting them can be a bit chaotic. Make sure there is plenty of room and perhaps make a rule that the young aerospace engineers need to walk to collect their helicopters after they land.

STEMAZing Teaching Philosophy

<u>Children should always be given ample time to experiment, notice, and wonder before they are provided an explanation.</u>

Always engage children with our two favorite questions:

What do you notice? What do you wonder?

Resist the urge to answer any questions children have while exploring. Instead, respond back with questions to children and let them make sense of the world. Sample questions you might use: What do you think? Do you notice any patterns? What could we change? Can we test something else? What can we try next? If children ask a testable question, which they could answer by doing an experiment, talk through with them how they might design a test to help answer their question. As much as possible and within reason, let them actually test their questions by trying the experiments they propose.

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Advanced Teacher Preparation

Print out the large and small paper helicopter templates on regular paper.

Notice and Wonder Developmentally Appropriate Practice

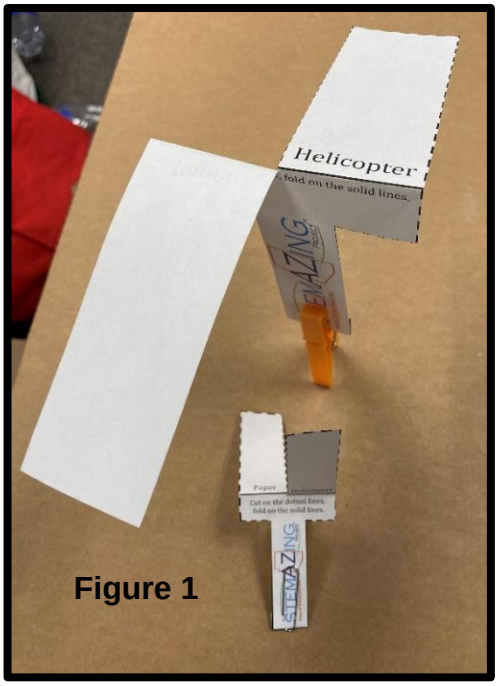

Figure 1

1. Help the young aerospace engineers build a large paper helicopter using a clothespin at the end of the base as shown in Figure 1. They can decorate them and put their names on them.
2. Demonstrate how they can throw the paper helicopter up in the air and then watch it come down.
3. Let them play with the large paper helicopters for a bit.
4. Help the young aerospace engineers build a small paper helicopter using a paper clip at the end of the base as shown in Figure 1. They can decorate them and put their names on them.
5. Demonstrate how they can throw the small paper helicopter or just drop it by holding it as high up as they can and letting it go.
6. Let them play with the small paper helicopters for a bit.
7. Ask the young aerospace engineers what they might change about the design of the paper helicopters. Brainstorm ideas as a group.
   - These could include:
     - Using different paper – cardstock or newspaper or cardboard
     - Changing the shape of the helicopter blades.
     - Changing the weight used – adding more or less clothespins and/or paper clips.
     - Changing the size of the helicopter – make one even bigger, even smaller, or in between the two original designs.
     - Changing the color of the paper.
     - Changing the number of blades.
8. As much as possible, let the young aerospace engineers make changes to their paper helicopters and decide if it makes it better or worse. Ask them to explain why it is better or worse and how they know. You might help them define “better” as the helicopter that stays in the air the longest.
9. If you have an elevated location like the top of a set of stairs, a balcony, or some playground equipment they can climb up, they can compare which helicopter designs are best by dropping them from the same height at the same time. (A teacher can also drop them from on top a table or chair.) The best helicopter is not the fastest one but the slowest – the one that takes the longest to hit the ground. (NOTE: Make sure to test the helicopters in at least five races to ensure the results are consistent.)

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Children should notice…

- the paper helicopters spin while they are falling downward.
- changes they make to the design sometimes improve its performance and sometimes make its performance worse.
- there are lots of ways to change the design of the paper helicopter that can be tested.

Differentiating Developmentally Appropriate Practice

Older students could use a timer to time the paper helicopters falling. You could also make them keep track of their data in a notebook along with their design changes. See the IDEAS Engineering Journal here: https://stemazing.org/ideas-engineering-journal/

Younger students may need more support from the teacher when building the paper helicopters with cutting and folding.

Extensions for Additional Learning

As always, ask the children throughout the experiment what they notice and what they wonder. If their wonder questions are testable, as much as possible and within reason, let them actually test their questions by trying new experiments.

See below for examples of what they might wonder and experiments they might do to test their wonderings.

- I wonder what would happen to the paper helicopters outside on a windy day?
  - Let them try it!
- I wonder if the paper helicopters could ever go up in the air instead of just falling down?
  - Let them try it! Let young aerospace engineers explore ideas they have about how they could get the helicopters to go up.
- I wonder how many times the helicopter turns around as it falls to the ground?
  - A ribbon can be taped to the bottom of the paper helicopter. It should be long enough to reach the ground when the helicopter is held up. Make sure the ribbon is not twisted at all and then have someone place their foot on the bottom of the ribbon on the floor to hold it in place. Drop the helicopter. As it spins it will twist up the ribbon. Then the ribbon can carefully be untwisted while counting the number of complete rotations.

#STEMAZingPictureBook Recommendations:

Baby Loves Aerospace Engineering! by Ruth Spiro – can discuss what an aerospace engineer is and discuss the four forces of flight.

Baby Loves Gravity! by Ruth Spiro – can discuss more about gravity with young scientists.

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AZ Early Learning Standards

Above and beyond the Social Emotional, Approaches to Learning, Language and Literacy, Social Studies, and Physical Development, Health, & Safety Standards which may naturally apply to the lesson, the following Science, Math, and Fine Arts Standards are strongly connected to this lesson:

Science Standard – Strand 1: Inquiry & Application

Concept 1: Exploration, Observation & Hypotheses – The child observes, explore, and interacts with materials, others, and the environment.

Concept 2: Investigation – The child researches their own predictions and the ideas of others through active exploration and experimentation.

Concept 3: Analysis and Conclusion – The child analyzes data (their observations and background knowledge) and forms conclusions about their investigation.

Concept 4: Communication – The child discusses, communicates, and reflects upon the scientific investigation and its findings.

Math Standard – Strand 3: Measurement and Data

Concept 2: Data Analysis – With prompting and support the child collects, organizes, displays, and describes relevant data.

Concept 3: Measures – The child uses measurement to describe and compare objects in the environment.

Paper Helicopters

What the heck? Explanation of the Science (Vocabulary in bold.)

Helicopters are loosely defined as flying objects with blades that spin. Blades on a real helicopter spin with help from a motor and are able to provide enough force pushing on the air to lift the helicopter up against gravity. The **blades** are the part of the helicopter that interact with the air to either make the helicopter spin, as in the case of the paper helicopter, or spin with the help of a motor to lift the helicopter up, as in the case of a real helicopter. The paper helicopters work by spinning as they fall to slow their descent. Many factors impact how long it takes the paper helicopters to fall. There is a balance between having enough weight to keep the helicopter oriented correctly so it will spin and having too much weight, which pulls it down quickly. Young aerospace engineers can experiment with different blade designs, paper types, weights, and other design features of the paper helicopter to attempt to slow it down even more. The best paper helicopter is one that takes the longest to fall to the ground!

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