

GIVE SPARK · THE PBL PLAYGROUND · A ONE-DAY SPARK

Raincoat *Rescue*

Which material will keep a toy dry?

Spark Teacher Guide
Grades 1–3 · Science and engineering · 60–90 minutes
Six teacher pages and two student recording pages

Spark *overview*

Which material will keep a toy dry?

Children predict which material will keep a toy dry, compare three materials, use their results to make a small raincoat, and test and improve it.

The challenge

A toy is heading outside, but rain is on the way. Your team must choose a material and make a raincoat that keeps its back dry. You will test the materials before choosing, then put your finished coat through a rain test.

What children should learn

Children use observations to choose a material for a purpose. They distinguish between water soaking into a material and water reaching the space underneath it. They also discover that a suitable material can still make a leaky coat if the shape leaves gaps.

Success looks like

1. We use our test results to explain our material choice.
2. Our coat stays on when the toy is lifted and moved.
3. The paper patch on the toy's back stays dry in our agreed rain test.

The patch makes "keep it dry" observable. The challenge protects the back, not every exposed part of the toy. The toy's face and feet remain uncovered; sealing it inside a bag does not meet the brief.

Make space for their ideas

Every child predicts before the group chooses. Children test before they build. Your explanation lands on what they have just noticed. And before the end, each child looks back at their first idea.

Curriculum connection: NGSS **2-PS1-2**, using test results to decide which material suits a purpose.



AT A GLANCE

- **Time:** 90 minutes, including cleanup. Timing options: page 7.
- **Grouping:** teams of three.
- **Focus:** material properties, fair comparisons and using evidence to improve a design.
- **Outcome:** one tested toy raincoat per team, with an explanation of the material choice and any change made.
- **Audience:** a neighbouring team during a short Raincoat Rescue Show.

SESSION AT A GLANCE

STAGE	MIN	PAGE
Meet the problem & predict	8	4
Compare materials	17	4
Explain & choose	8	5
Plan & make	20	5
Test, improve & retest	20	6
Share & reflect	10	7
Clean up	7	7
Total	**90**	

Materials & preparation → **p. 3**

Student recording pages → **pp. 8–9**

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Materials & *preparation*

Materials, preparation and the two test setups. Allow about 45 minutes the first time, including cutting the squares and fitting the samples; about 15 minutes once the kits exist.

For each team of three

- One small washable, non-electronic plastic toy, approximately 8–12 cm tall.
- Three identical clear plastic cups with openings no wider than about 6 cm.
- Three 10 × 10 cm test squares: **paper towel**, **uncoated cotton fabric** and **flexible waterproof plastic** cut from clean packaging.
- Three rubber bands to hold the samples over the cups; adults can fit these.
- Larger dry pieces of the same three materials, approximately 20 × 20 cm, for building.
- At least eight small pieces of dry paper towel: three for the material tests, two for the coat tests and spares.
- One 5 mL measuring teaspoon and a small pot with approximately 100 mL of water.
- One shallow tray, a wiping cloth, blunt scissors, short strips of tape and a pencil.
- One copy of each student page per child, or one shared test table plus individual predictions and final explanations.

For a class of 30 working in threes, prepare ten kits, plus spare dry samples and building pieces. Keep all water testing inside trays.

Set up the material test

Put a dry paper piece in the bottom of each cup. Secure one sample across each opening, with the same side facing upwards, one layer and similar tension. The sample must cover the entire opening. Label the cups with the material names. The paper at the bottom will show whether water has passed through.

This first test is about the flat materials. The toy test later is about the finished coat. Keeping the two apart helps children see the difference between a material that lets water through and a coat with a gap in it.

Set up the toy

Decide which part of the back the coat must protect. A fresh paper patch sits against that spot, under the coat, for every rain test. A short piece of tape at the patch's top edge is enough to hold it. Keep the same toy for a team's first test and retest; similar-sized toys across teams make sharing easier.



The material test. One sample stretched flat over the cup with a rubber band. Dry paper in the bottom shows whether water got through.

TRY IT FIRST

Run the test once with your own samples: two 5 mL spoonfuls to the centre, then a 30-second wait. Thickness and coatings change the result, so if you need a different amount, pick one and use it for every material so children can compare fairly.

SAFETY

Cut plastic packaging into flat sheets before the lesson. Supervise scissors, small toys and rubber bands, and wipe spills as they happen.

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TEACHING SEQUENCE

Predict & test *materials*

A prediction from every child, then a fair comparison of the three materials.

Meet the problem 8 MINUTES

SAY *"Our toy needs to go out in the rain. Here are three materials we could use for its coat. Which would you choose? What makes you think that?"*

DO Show the toy and dry samples. Let children look, touch and bend them. Each child circles or draws a prediction on student page 1 and gives a reason to a partner. Record a few contrasting ideas without announcing the best material. Then introduce the challenge and agree how the class will judge success. Show the dry paper patch: if it gets wet underneath the coat, water has reached the toy's back.

ASK

- "Does feeling soft tell us whether it will keep water out?"
- "What do we need to find out before we make the coat?"
- "How could we compare the materials fairly?"

LOOK FOR Children choosing by look or feel, children sure that thick means waterproof, and children already connecting the choice to a raincoat they own. All of these give the test something to answer.

Compare the materials 17 MINUTES

DO Demonstrate the method, then let teams test. Use three rotating jobs: **water tester**, **observer** and **recorder**. Swap jobs for each material.

1. Check that the cup, the paper inside it and the sample are dry.
2. Add two 5 mL spoonfuls slowly to the centre of the sample, keeping the spoon close to the surface. Keep water away from the rubber band and cup rim.
3. Wait 30 seconds. Notice whether the water sits on top, soaks in or drips through.
4. Inspect the paper at the bottom through the clear cup. Record **dry** or **wet**.
5. Repeat with the other materials using the same method.

> **Keep the same:** sample size, one layer, cup opening, water amount, delivery method and waiting time. **Change:** the material.

Record what the material did as well as whether the paper underneath got wet. A sample can soak up water without dripping through; both things are worth noticing.

ASK

- "What happened on top? What happened underneath?"
- "What evidence will help us choose?"
- "Was anything different about this test that makes us unsure?"

IF THIS HAPPENS

Water runs round the edge of the sample, the paper was already damp, or the sample tears. Call that one uncertain and run it again with a dry cup, fresh paper and a new sample.

ROLES

Water tester delivers the two spoonfuls. **Observer** watches the top of the sample and the paper below. **Recorder** fills in the table. Swap after each material so every child does each job once.

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TEACHING SEQUENCE

Plan & build the *raincoat*

A short explanation that lands on what children saw, then they use what they discovered to choose a material and design the coat.

Explain and choose 8 MINUTES

DO Ask teams to bring one observation to the discussion. Connect the explanation to their results.

SAY *"A material is what something is made from. Its properties describe what it is like and how it behaves. An absorbent material soaks up water. For a raincoat, we want a material that keeps water from reaching what is underneath. Waterproof materials stop water passing through, but water can still get around an edge or through a hole."*

"When you say your material worked, point to the result that helped you decide. Our test tells us what happened with these samples and this amount of water."

Dry paper underneath does not always mean the sample stayed dry. If a material soaked the water up without dripping, ask whether it would cope with a longer shower. An unexpected result is worth a second look at the sample and the setup.

Use what you discovered to choose your material. Each team completes: *"We will use ____ because our test showed ____."* Children can change their first prediction; ask what made them change. If two materials did equally well, talk about which bends, which tears and which is easiest to fit round the toy.

ASK

- "Where might water find a way in?"
- "Will this overlap send water outside the coat or underneath it?"
- "Can you put the coat on without tearing it?"

LOOK FOR

Children using their test results, thinking about coverage and fit, and bringing every teammate into the decisions. Look beyond the finished coat: listen to how they explain their choices.

TWO WORDS THAT MATTER

Absorbent: soaks up water.
Waterproof: stops water passing through. Even a waterproof material can make a leaky coat. Look closely at the joins and gaps.

Plan and make 20 MINUTES

DO Give approximately 3 minutes for a sketch, 14 minutes to build and 3 minutes to check the fit. Children draw the toy, show the area to cover and label the chosen material. One useful sketch is enough.

Build constraints

- Use a dry piece of a material the team has tested.
- Make a coat or cape the toy can wear, with its face and feet uncovered.
- Use tape to join or secure the coat, not to cover its entire surface.
- Keep the paper patch area covered.
- Save decoration until the coat has been tested.

A cape or a wrap is plenty. No sleeves, no sewing, no hood needed. A shared starter outline helps with cutting; the material and how it goes on are the children's decisions.

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Test & improve the *raincoat*

Twenty minutes for the first test, a quick diagnosis, one change and a retest. Test at each group's own tray so nobody queues. Show the rain method once, then children swap testing and observing roles.

The toy rain test

1. Dry the toy and fit a fresh dry paper patch against its back.
2. Put the coat on. Lift the toy and move it a short distance to check that the coat stays in place.
3. Stand or support the toy in the tray in an agreed position.
4. Deliver two 5 mL spoonfuls of water as a slow drizzle over the covered back from approximately 10 cm above, taking about 10 seconds in total. Spread the drizzle across that area rather than pouring at one point.
5. Wait 30 seconds.
6. Remove the coat carefully, keeping its wet outside away from the paper patch.
7. Check the patch and record **dry** or **wet**. Locate any wet area and photograph or sketch it if helpful.

Keep the retest the same: water amount, height, time, position and wait. It is a classroom comparison, so the same shower every time is what makes it fair.

Find the reason

WHAT CHILDREN NOTICE	A USEFUL QUESTION	POSSIBLE CHANGE
The back is not fully covered	"Where did the water get in?"	Extend or reposition the coat
Water enters at a join	"Which way does this overlap face?"	Change the overlap or secure the join
Water passes through the material	"How does this compare with our material test?"	Use a better-performing tested material
The material tears	"Where did it tear, and what pulled on it?"	Change the cut or fastening
The coat falls off	"Which part needs to hold it in place?"	Adjust one fastening

SAY *"Choose one change that could help. Tell us why you think it will work. Then we can test again and see."*

Note the first result, then dry the toy, fit a new patch and dry or remake the coat before testing again. One change at a time, so children can connect the change to the result. If the coat works first time, test it again: does it keep the toy dry twice?



The patch. Dry paper towel on the toy's back, held by one short piece of tape.



Ready to test. The coat covers the patch; head and feet stay uncovered.

LOOK FOR

Children naming a likely cause before reaching for the tape, and noticing that a better material will not fix a gap.

IF THIS HAPPENS

The patch gets wet as the coat comes off. Call it uncertain and test again rather than counting it as a failure.

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TEACHING SEQUENCE

Share, reflect & *assess*

A brief showcase, a return to the first idea, an individual learning check, and the support and timing options.

Raincoat Rescue Show 10 MINUTES

DO Pair neighbouring teams. Each team shows its coat and explains it in under a minute: *"We chose ____ because ____. In our rain test ____. We changed ____ because ____."* If nothing needed changing: *"We tested it again to check ____. We found ____."* The listening team asks one question about the evidence or the design.

Return to the original idea

Each child finishes the reflection on student page 2: *"At first I thought ____. Now I think ____ because ____."* Keeping a first idea is fine if the results back it up. The reason is what matters.

Check each child's understanding

Show or describe a coat made from a material that kept the test paper dry, but with a gap over the toy's back.

ASK

- "The material worked in our test. Could the toy still get wet? How?"

LOOK FOR An explanation that water could get in through the gap. Then ask each child to point to one result that supports their own material choice; a working group coat does not tell you what every child understands.

Teacher assessment notes

- Uses an observed result to justify a choice.
- Identifies something kept the same during the material comparison.
- Distinguishes water passing through a material from water getting through a gap.
- Explains a change, or why a repeat test was useful.

Three quick marks: **independent**, **with prompting**, **not yet observed**. You are listening for reasoning, not spelling or cutting.

Support and challenge

LEARNERS	ADJUSTMENT
Grade 1, or children needing practical support	Pre-fit samples over cups, offer a cape outline, use picture choices and accept oral or dictated explanations.
Grade 2	Children record observations, explain a fair comparison and link one design change to the result.
Grade 3, or children ready for more	Repeat an uncertain result, compare the pattern across groups and explain what their test does and does not establish.

Everyone works on the same question; what changes is how much recording and independence each child takes on. **Clean up, 7 minutes:** empty cups and trays, wipe toys, collect reusable plastic and fabric, dry surfaces, wash hands.

60-MINUTE SUPPORTED VERSION

Prepare the cup tests and cut the building pieces in advance. Run the material comparison as a demonstration, with children predicting and recording. Keep the plan to a quick sketch, and keep a first test, one change or a repeat, and the return to their first idea.

Brief and individual prediction	5
Teacher-led comparison	12
Explanation and choice	5
Sketch and build	13
Test and improve or repeat	14
Share and individual check	6
Cleanup	5
Total	**60**

UP TO 120 MINUTES

Add up to 30 minutes: repeat a material test with fresh samples, compare results across groups, and allow one more improvement and retest. Stay on the same question.

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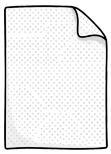
My material test

Which material will keep a toy dry?

Name: _____

1 My prediction

Circle the material you think will keep **the toy dry**.



Paper towel



Cotton fabric

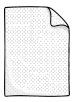


Plastic

I think this because...

2 Our material test

Draw or write what you notice. Circle a result.

Material	What happened to the water? On the material	Paper underneath
 **Paper towel**		Dry / Wet / Not sure
 **Cotton fabric**		Dry / Wet / Not sure
 **Plastic**		Dry / Wet / Not sure

Not sure? Test again.

 **Same size** |  **Same water** |  **Same wait**

3 Our choice

We will use...

Our test showed...

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Our raincoat rescue

Name: _____

1 Our plan

Draw your coat. Label the material. Show where it will cover the toy.



2 Our first test

Circle your results.

Paper patch:	Dry	Wet	Not sure	The coat stayed on:	Yes	Not yet
			?			

3 Our next step

Choose one.

☐ **We will change...**

because...

☐ **It worked. We will test it again.**

4 Our next test

Circle your results.

Paper patch:	Dry	Wet	Not sure	The coat stayed on:	Yes	Not yet
			?			

Not sure? Use a fresh dry patch and test again.

5 My thinking now

Draw or write.

At first I thought...

Now I think...

because...

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