

a | paper tech  
printable lesson

1

Cut out all parts and score/pre-bend all of the fold lines. The stand is doubled-up for strength. Glue it to expose either the red or the white side, your choice!

2

Attach the stand to the book by glueing foot ① onto the ① flap near the gutter. Repeat for ② . Now glue ③ to ③ and ④ to ④ in order to attach the cone to the book.

3

Tie the thread's end tightly to fastener ⑤ and bring the thread through hole ⑥ . Then enter into the speaker through ⑥ , out again through ⑥ , in through ⑥ , and out through ⑥ .

4

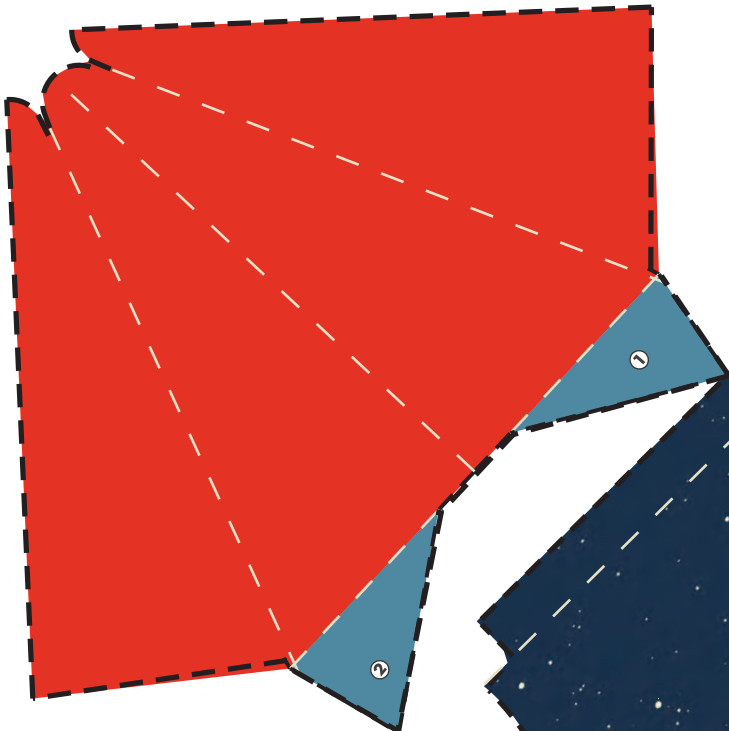
The thread exits the book through hole ⑥ . Close the book and pull the thread taut. Leaving a finger's width of slack, tie the string tightly around fastener ⑥ . Adjust string tautness to make the cone opening circular, rather than ovoid.



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(pop-up adapted from *This Book is a Planetarium*)

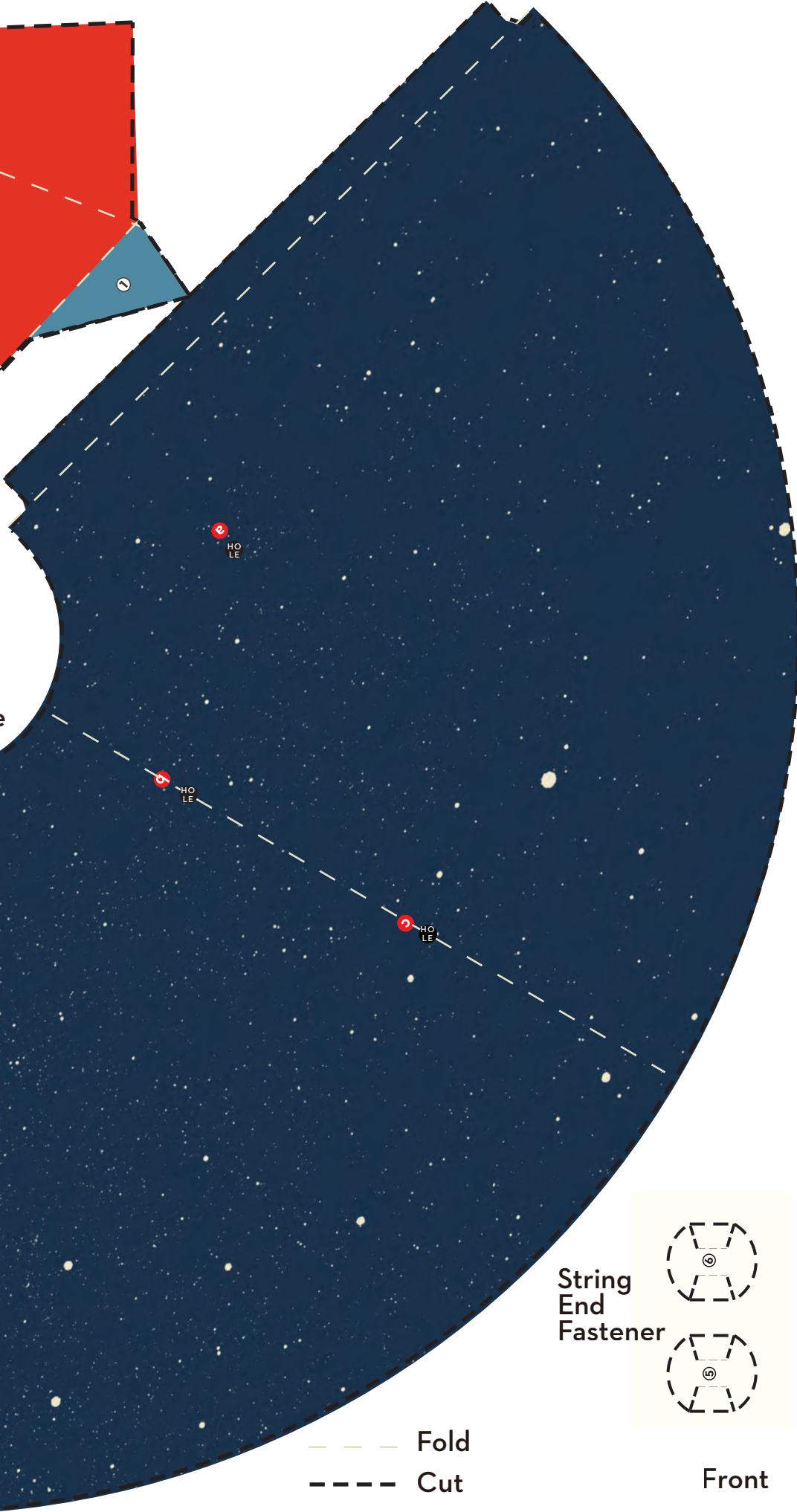
diy paper amplifier for  
your phone

# Speaker



Smartphone  
Stand

Inside of  
Megaphone



HOLE

HOLE

HOLE

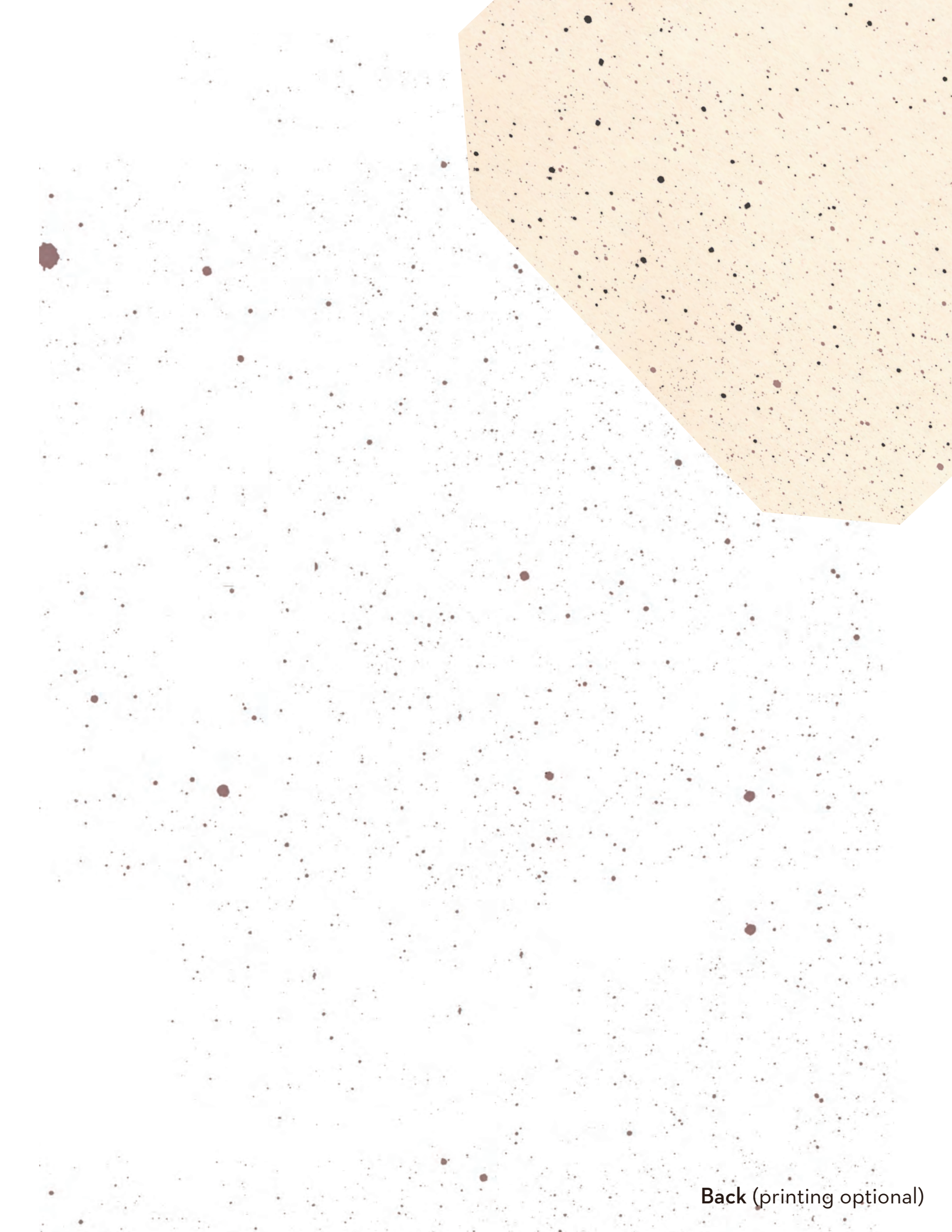
HOLE

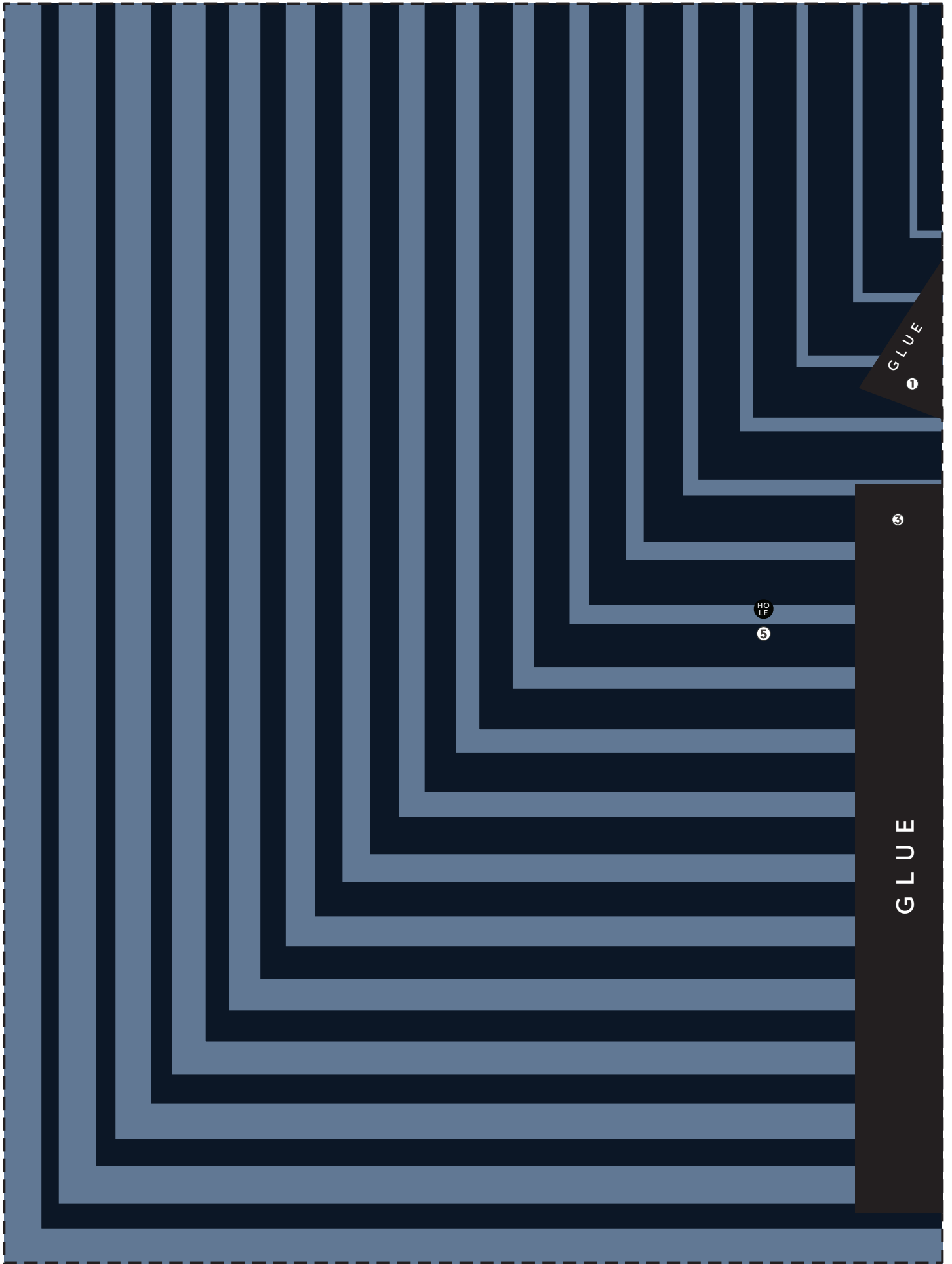
String  
End  
Fastener



--- Fold  
--- Cut

Front





Left page (printing optional)

Begin playing a song on your phone and place it in the pop-up stand behind the cone. Nudge phone to the left or right to center its speaker. Sound will be amplified in your direction.

GLUE

2

4

HOLE

6

GLUE

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## Why it works

The speaker works because its conical structure takes advantage of how sound waves travel through the air. Some types of waves—such as AM/FM radio waves—pass through solid surfaces, while others—such as sound waves—are directional, and bounce and refract off of objects.

Normally, when sound waves exist a tiny speaker, they rapidly disperse far and wide, eventually receding back into the stasis of silence. Here, sound enters the small taper of the cone, and its widening shape traps and delays the waves' escape. The cone corrals the sound waves, so that they bounce out in unison, resulting in a composite (and seemingly amplified) sound.

## Understanding it even more...

- Stand directly in front of the speaker. Now hop to the left. Why do you think the sound is less loud?
- What happens when you put various objects in front of the speaker? What about a person?
- What happens when you tape tin foil onto the speaker?



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