

Instructor Guide

Suggested timing: 20-25 minutes

LEARNING TARGETS

Students should be able to explain why basis agreement is required, why wrong-basis measurement is random, how intercept-resend introduces errors, and why bits revealed during comparison cannot remain secret.

PRINTING AND LICENSE

Per group: print pages 2, 3, and 5 twice if running both scenarios; print page 4 once. Page 1 may be shared. Licensed under CC BY 4.0: [share and adapt with attribution. creativecommons.org/licenses/by/4.0/](https://creativecommons.org/licenses/by/4.0/)

RECOMMENDED CLASSROOM FLOW

Time	Activity	Instructor cue
2 min	Assign Alice and Bob; optionally Eve	Give each role only its own worksheet.
5 min	Run 1: no Eve	Alice sends directly to Bob. Their sifted bits should match.
3 min	Sift and compare	Compare every kept bit for this classroom demonstration.
5 min	Run 2: with Eve	Alice sends to Eve; Eve measures and resends to Bob.
3 min	Sift and compare again	Compare the observed error rate with Run 1.
5 min	Debrief	Connect the coin flips to incompatible quantum bases.

WHAT STUDENTS SHOULD OBSERVE

Without Eve, every sifted bit should match. With intercept-resend, Eve chooses the wrong basis about half the time; when Alice and Bob later keep a round, that disturbance produces a Bob-Alice mismatch about half of those disturbed rounds. Therefore, the idealized error rate among sifted bits is about 25% under a full intercept-resend attack.

SMALL-SAMPLE WARNING

Eight rounds make a fast demonstration, not a reliable statistical test. A run can show no detected mismatch by chance. Pool results across groups or repeat with 16-32 rounds.

DEBRIEF QUESTIONS

1. Why can Alice and Bob reveal their bases without revealing their bit values?
2. Where exactly does Eve introduce disturbance?
3. Why is this classroom sifted key no longer secret, and what does real BB84 reveal instead?
4. What real-world effects besides Eve could cause mismatches?
5. What additional classical-channel property does BB84 require? (Authentication.)