

# Mirror-Tracing Activity

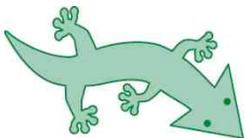


## About This Activity

This activity complements the 2008 HHMI Holiday Lectures on Science—*Making Your Mind: Molecules, Motion, and Memory*.

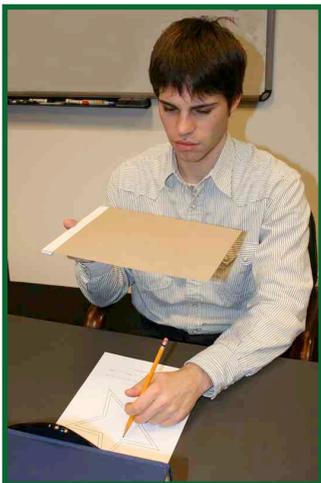
It takes an hour each day for three consecutive days to complete this activity.

**Read through the whole document before starting your activity.**



Visit [holidaylectures.org](http://holidaylectures.org)

- Downloadable version of this document
- More information on the Holiday Lectures on Science



## Learning a Motor Skill

When we discuss memories, we often mean memories of facts and events: What you did last Sunday, the capital of Austria, your best friend's cell phone number. There is another kind of memory that is largely unconscious, but very important. We learn and remember essential skills, such as walking, using chopsticks, or riding a bicycle.

The mirror-tracing activity is a visual and motor test that involves learning a new motor skill. The task requires you to move a pencil to trace the diagram of a star while looking at your hand only as a reflection in a mirror. The act of drawing is a learned skill that requires visual and proprioceptive

feedback to control muscle movement. Proprioception is a special sense that tells your brain the position of various parts of your body, and is discussed by Dr. Jessell in lecture 3. What happens when the visual feedback that our brain receives is not what is expected? By concentrated effort, can we overcome a reversed visual field and follow new rules? Can we learn these new rules and improve with practice?

The results obtained from students attending the 2008 Holiday Lectures on Science were pooled together, and the data compared to other groups, including a famous patient referred to as HM, who was discussed by Dr. Kandel in lecture 4.

## What You Need for This Activity

30 star pattern-tracing sheets (an original for you to make copies from is attached). You will need all 30. If you want to share this activity with others, make additional copies.

Practice-tracing sheet for use without a mirror (attached).

A mirror.

Cardboard to block direct viewing of your hand when tracing.

A pencil for tracing and recording your results.

A clock, watch, or stopwatch for keeping time. Whatever timepiece you use must be able to measure seconds.

Tape to hold the paper in place while tracing.

## Plan Your Activity

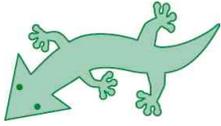
You are going to trace the diagram of a star while looking at your hand only as a reflection in a mirror.

Plan and budget time to do 10 tracings each day for 3 consecutive days. We estimate that you will need 30–60 minutes to complete 10 tracings.

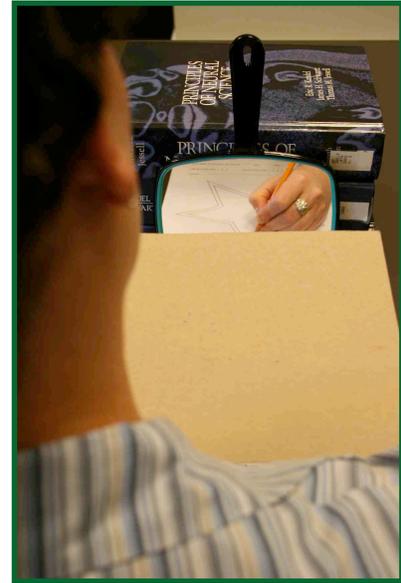
You will need a flat surface with enough elbow room to do your tracing, such as a cleared desk or table.

It is important that you completely fill in all of your 30 tracing sheets.

**Be sure you do your tracings each day, and don't do any practice trials that you don't count. Doing so could invalidate the results.**

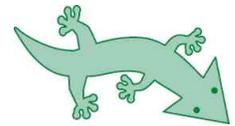


Adjust your mirror and cardboard until you see something similar to this. Note that you can see your hand only in the mirror.



## Make Your Tracings

1. Before starting the activity, use the practice sheet to trace the star pattern **without a mirror**. Try tracing clockwise and counterclockwise and decide which feels most comfortable. You can use either hand. Use the most comfortable combination (e.g., left-handed clockwise) for all of the actual trials.
2. Decide how you want to arrange the mirror and the cardboard. You need to arrange the mirror so that you can view your hand on the star pattern in the mirror, while using the cardboard to block your direct view of your hand. One possibility is to prop up the mirror so you don't have to hold it. Another is to use a large fixed mirror such as found on a dresser, a vanity or in a bathroom. Or you could hold a hand mirror and have someone else assist you by holding the cardboard under your chin to block your view.
3. Place a star pattern-tracing sheet on your surface. Tape it to hold it in place.
4. Write down your name, and circle the appropriate day # (1–3) and trial # (1–10) on the sheet.
5. Move things around until you are comfortable. Do not look directly at your hand while tracing. Do not cheat!
6. Check and record the time.
7. Place the pencil point on the start mark (S). You can peek around the visual barrier to do this step only.
8. Trace the star pattern, trying to stay between the double lines. Keep the line continuous (i.e., **do not lift the pencil at any time**).
9. If your line exits outside of the star completely, bring the line back in between the lines as close to the point where you exited as possible. Do this without lifting up your pencil. Do not start over.
10. To finish, you must bring your line all the way around the star and back to where you first placed your pencil.
11. Check and record the time when you finish.
12. When you have finished the tracing, score your sheet according to the guidelines given in the next section, "Score and Record Your Results." Rest your hand between tracing trials.
13. Repeat until you have done 10 tracings each day for 3 days, for a total of 30 tracings.



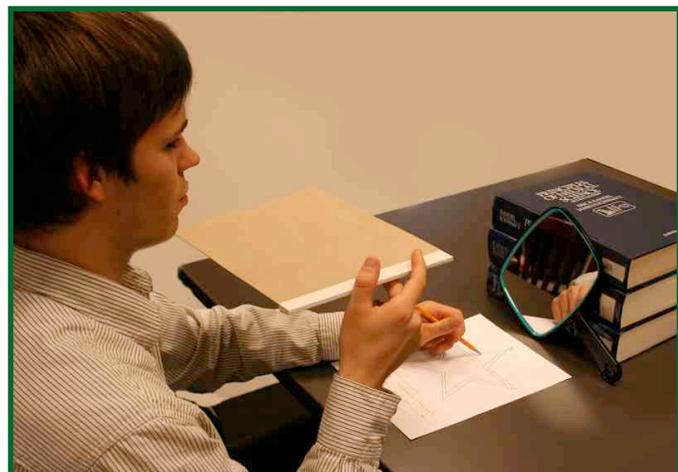
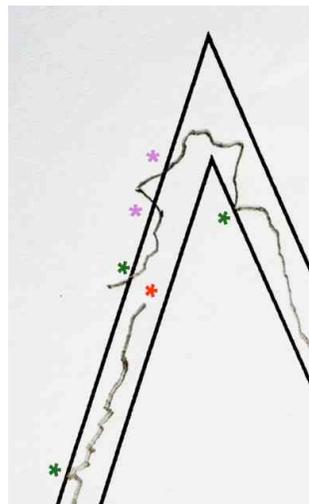
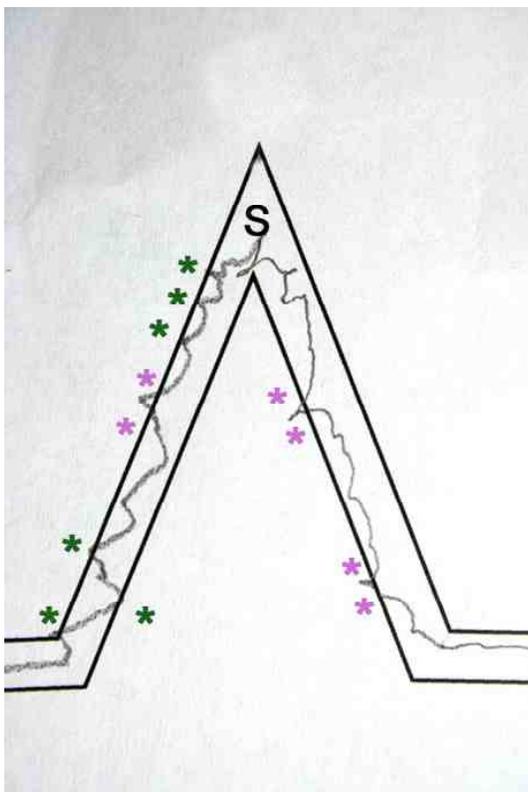
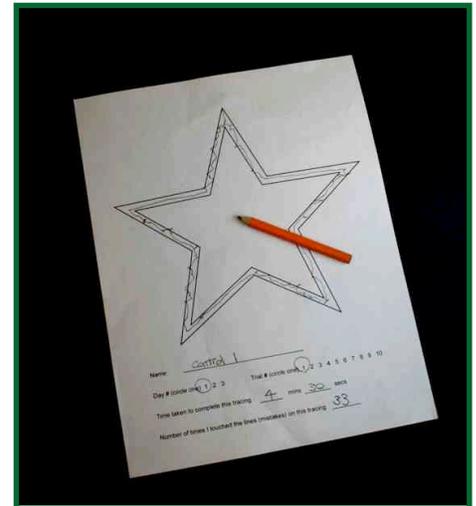
## Score and Record Your Results

First, calculate and record how long it took you to do each tracing.

Now carefully count the number of times that you touched a line. Refer to the example tracings below.

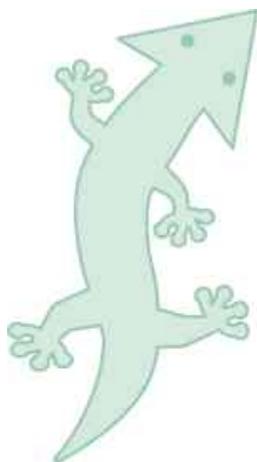
1. Each time you touch a line, count it as one error (green asterisk)
2. Each time you go over a line, count one error for going out, and count one error for coming back (pink asterisk)
3. If there is a break in the line, count one error (red asterisk)
4. If in doubt, count it as an error. Don't feel bad—this is hard to do. Enter on your score sheet the total number of errors for the trial.

Your first trials are likely to have a high number of errors and take a long time to complete. As your brain learns the task, it should become easier to do.



**Visit****[BioInteractive.org](http://www.BioInteractive.org)**

- Annotated 2-D and 3-D animations
- Virtual labs and other interactive resources
- Web video clips, virtual museums, and more

**Report Your Results**

After you have analyzed all of your data, report your results to your teacher or program coordinator in the format shown below:

**Sample Data**

Day 1 # of errors: 40, 32, 25, 20, 15, 18, 15, 12, 10, 9

Day 1 times in seconds: 330, 260, 250, 260, 190, 190, 200, 160, 130, 100

Day 2 # of errors: (sequence of 10 numbers)

Day 2 times in seconds: (sequence of 10 numbers)

Day 3 # of errors: (sequence of 10 numbers)

Day 3 times in seconds: (sequence of 10 numbers)

Your name

Your school name

Age

These should be in chronological order. In this case, the first trial of Day 1 had 40 errors and took 5 minutes and 30 seconds or 330 seconds to complete, the second trial had 32 errors and took 4 minutes and 20 seconds or 260 seconds to complete, etc.

**About the Holiday Lectures on Science and BioInteractive.org**

As part of its mission to strengthen science education, HHMI presents the Holiday Lectures on Science, an annual series that brings the latest developments in a rapidly moving field of research into the classroom. The lectures are given by HHMI investigators and other leading scientists. The 2008 Holiday Lectures, *Making Your Mind: Molecules, Motion, and Memory*, are the sixteenth in the series, which began in 1993.

To complement the Holiday Lectures and enhance their usefulness in the classroom, HHMI produces a variety of free science education materials. Lecture summaries, biographies of the lecturers, and other resources are at [www.holidaylectures.org](http://www.holidaylectures.org). DVDs and CD-ROMs can be ordered through HHMI's Catalog at <http://catalog.hhmi.org>.

The BioInteractive website ([www.BioInteractive.org](http://www.BioInteractive.org)) features virtual labs, animations, and other engaging instructional materials. They can be used to supplement the lecture topics or to learn important concepts in the biomedical sciences.

**HHMI**

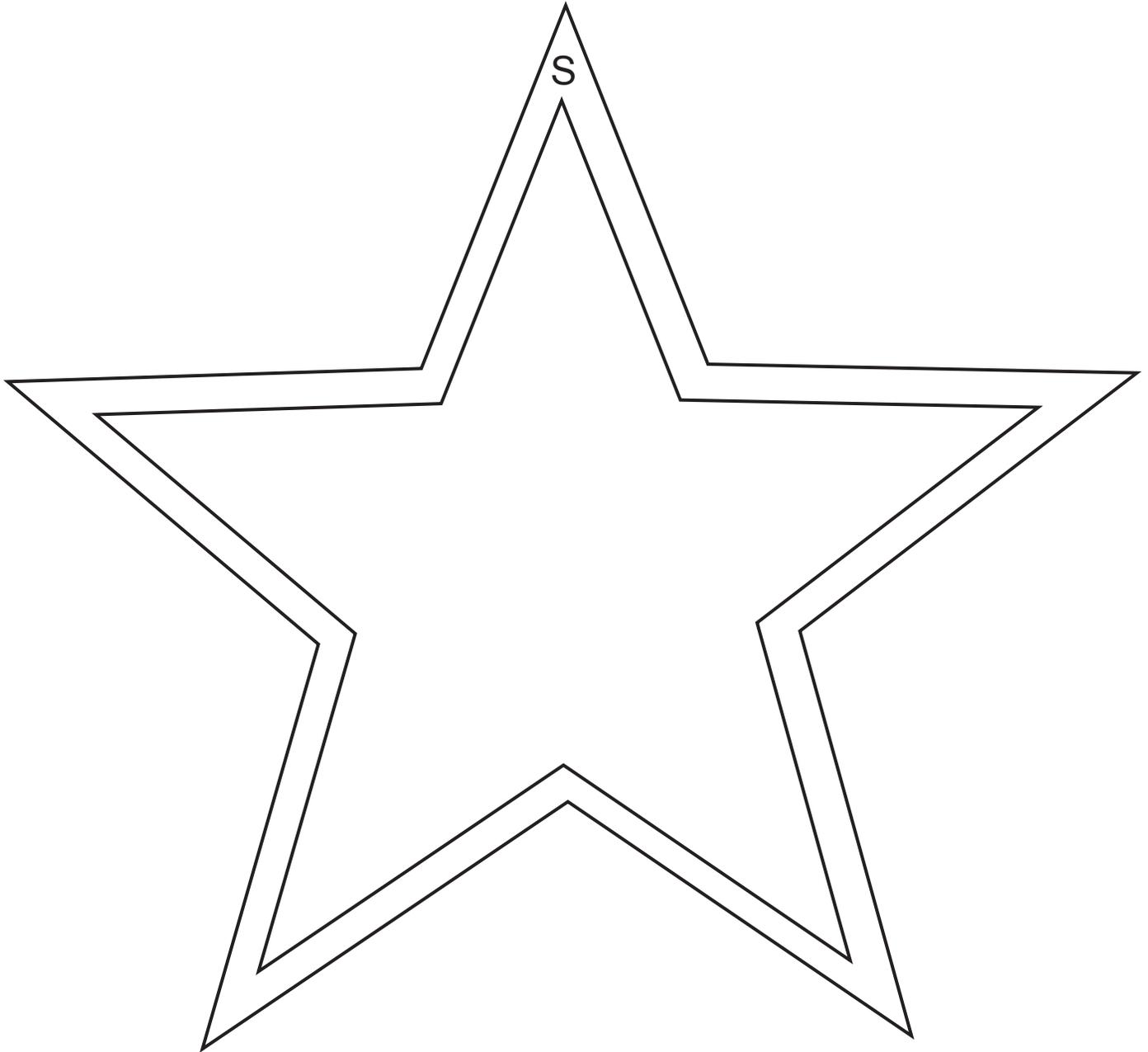
HOWARD HUGHES MEDICAL INSTITUTE

**Office of Grants and Special Programs**  
4000 Jones Bridge Road, Chevy Chase, MD 20815  
(301) 215-8500 • [biointeractive@hhmi.org](mailto:biointeractive@hhmi.org)

**About the Howard Hughes Medical Institute**

The Howard Hughes Medical Institute is a nonprofit medical research organization that employs hundreds of leading biomedical scientists working at the forefront of their fields. In addition, through its grants program and other activities, HHMI is helping enhance science education at all levels and maintain the vigor of biomedical science worldwide. Headquartered in Chevy Chase, Maryland, HHMI is one of the world's largest philanthropies, with laboratories across the United States and grants programs throughout the world.

The views and opinions expressed in this publication are not necessarily those of the Trustees or management of the Howard Hughes Medical Institute.

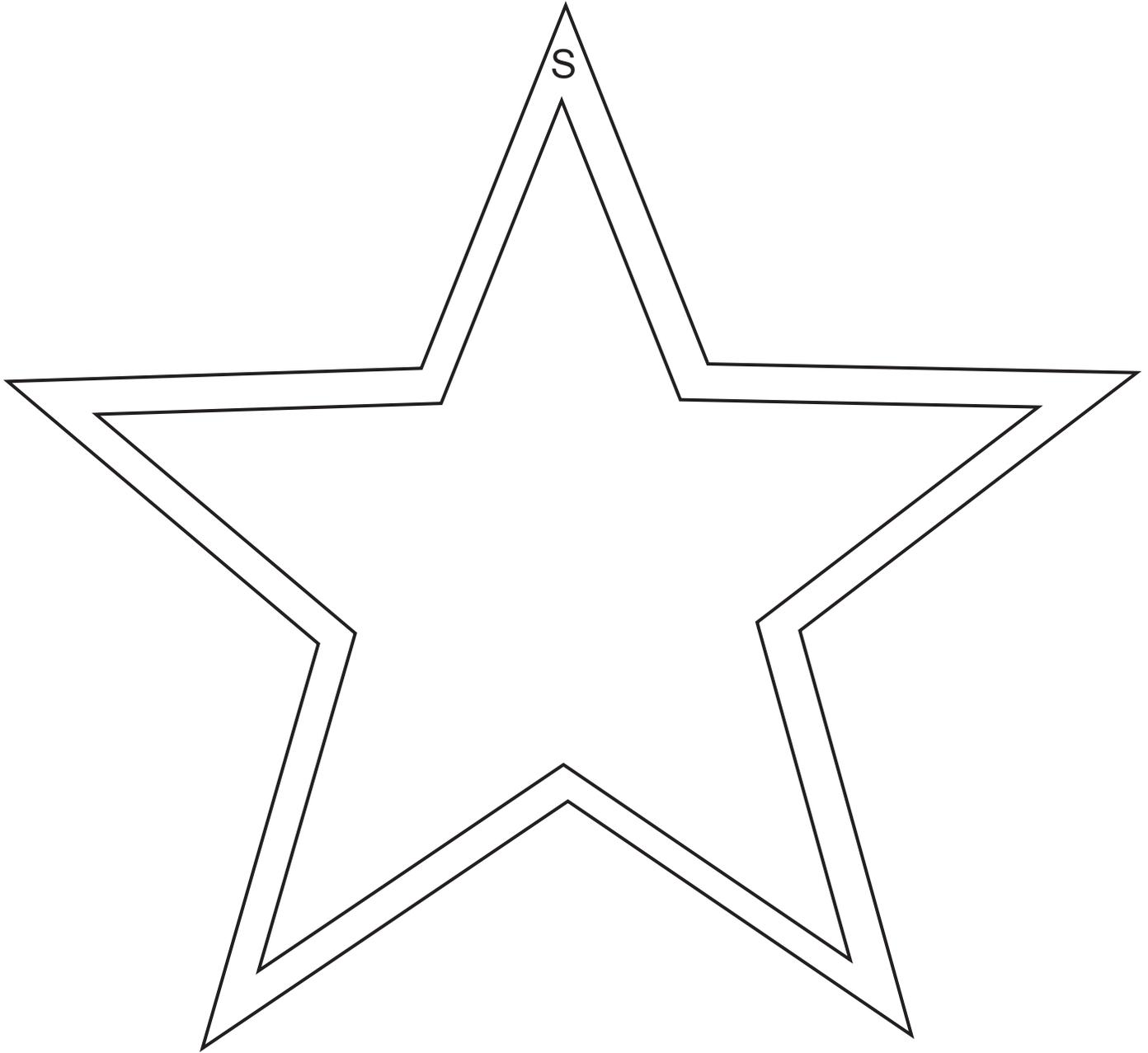


## Practice Sheet

Trace the star without using a mirror.

Try it right-handed, left-handed, clockwise, and counter-clockwise to decide what feels most comfortable or easiest.

Then use the combination most comfortable (e.g. left-handed clockwise) for the actual trials.



Name: \_\_\_\_\_

Day # (circle one) 1 2 3

Trial # (circle one) 1 2 3 4 5 6 7 8 9 10

Time taken to complete this tracing: \_\_\_\_\_ mins \_\_\_\_\_ secs = \_\_\_\_\_ secs

Number of errors on this tracing \_\_\_\_\_