

## SUPPLEMENTARY INFORMATION LIST GENESDEV/2017/311084\_Mendez-Dorantes

**Fig. S1.** A control experiment with the RMD-GFP reporter showing that GFP<sup>+</sup> cells have lost a selectable marker (hygromycin-resistance/*hyg*) that is between the repeats. Analysis of a distinct WT RMD-GFP clone.

**Fig. S2.** Shown are diagrams of the DR-GFP and EJ5-GFP reporters used in Fig. 2 and 3.

**Fig. S3.** Shown is the data from Fig. 3 in linear bar graph form, to facilitate individual comparisons.

**Fig. S4.** Shown is the data from Fig. 4 in linear bar graph form, to facilitate individual comparisons. Also shown is immunoblotting analysis confirming loss of 53BP1 and/or KU70 in the respective cell lines that are used in Fig. 4.

**Fig. S5.** Shown is the sequence of the repeat used for each reporter assay (Fig. 1A, 6A). Also shown are control experiments to examine the GFP<sup>+</sup> product of the divergent repeat reporters.

**Fig. S6.** Shown is the data from Fig. 6 in linear bar graph form, to facilitate individual comparisons. Also shown is the analysis of the RMD-GFP parental reporter in *Msh2*<sup>-/-</sup> cells, to allow comparison with the divergent RMD reporters.

**Fig. S7.** Shown is the data from Fig. 7A and 7B in linear bar graph form, to facilitate individual comparisons. Also shown is immunoblotting analysis confirming loss of KU70 and MSH2 in the *Msh2*<sup>-/-</sup>*Ku70*<sup>-/-</sup> mESC line.

**Fig. S8.** Shown is the data from Fig. 7C in linear bar graph form, to facilitate individual comparisons. Also shown is immunoblotting analysis confirming KU70 and MSH2 expression from the complementation vectors in the *Msh2*<sup>-/-</sup>*Ku70*<sup>-/-</sup> mESC line.

**Fig. S9.** Shown are cell cycle profiles of all cell lines used in the study.

**Table S1.** Shown are the sgRNA sequences and primers used in the study.